The MINING CONGRESS JOURNAL

Volume 14 NOVEMBER, 1928 *No. 11*

Charles W. Merrill, Robert E. Tally, Frank H. Probert, George J. Stein, Charles A. Carpenter, R. D. Leitch, L. C. Ilsley, G. B. Southward.

It takes MONTHS

for the assembled congress to transact the nation's business. Leaders in the important mining industry cannot take so much time in collective deliberation. They concentrate in one week the best thought of the industry to developing a program of performance that can be the guide for efficiency in production. Hence the importance of attending all sessions of the THIRTY-FIRST ANNUAL CONVENTION OF THE AMERICAN MINING CONGRESS to be held in Washington, December 5 to 8.

See Page 806 for an Editorial outlining Convention plans.

Mayflower Hotel

Convention Headquarters

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The MINING CONGRESS JOURNAL

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Safeguarding Electrical Equipment Used in Gassy Mines

Published Every Month by The American Mining Congress, Washington, D. C.

Edited under the supervision of James F. Calbreath, Secretary of The American Mining Congress

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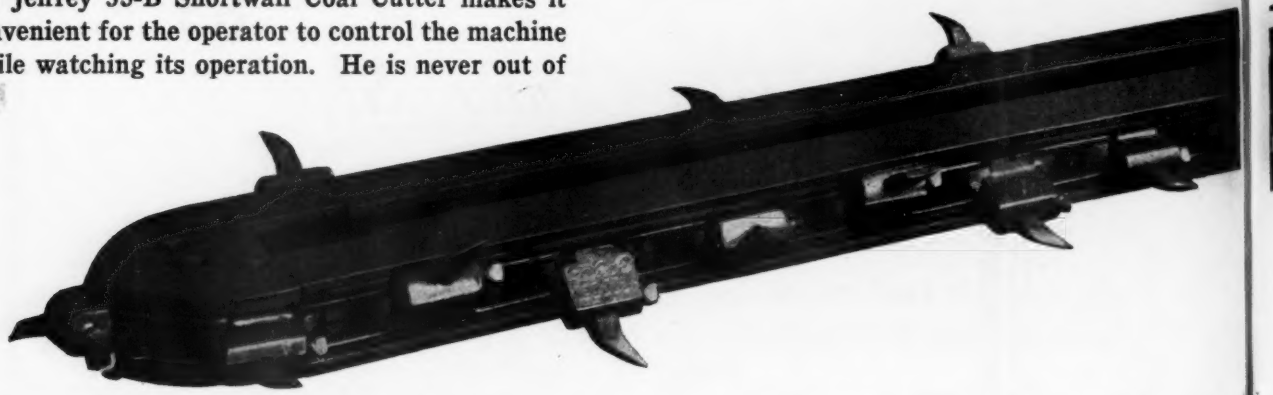
This Government Approved Jeffrey 35-B Shortwall Coal Cutter Has—

Centralized Control

Centering all the controls at the left rear corner of the Jeffrey 35-B Shortwall Coal Cutter makes it convenient for the operator to control the machine while watching its operation. He is never out of reach of the controls when laying skids. These features add to the safety of the machine runner and gain valuable production time.



Fewer Gears Than Any Other Shortwall Cutter

This feature of the Jeffrey 35-B Shortwall makes possible the use of larger gears, shafting and bearings and provides easy and proper lubrication of all parts, insuring longer life and greater dependability.

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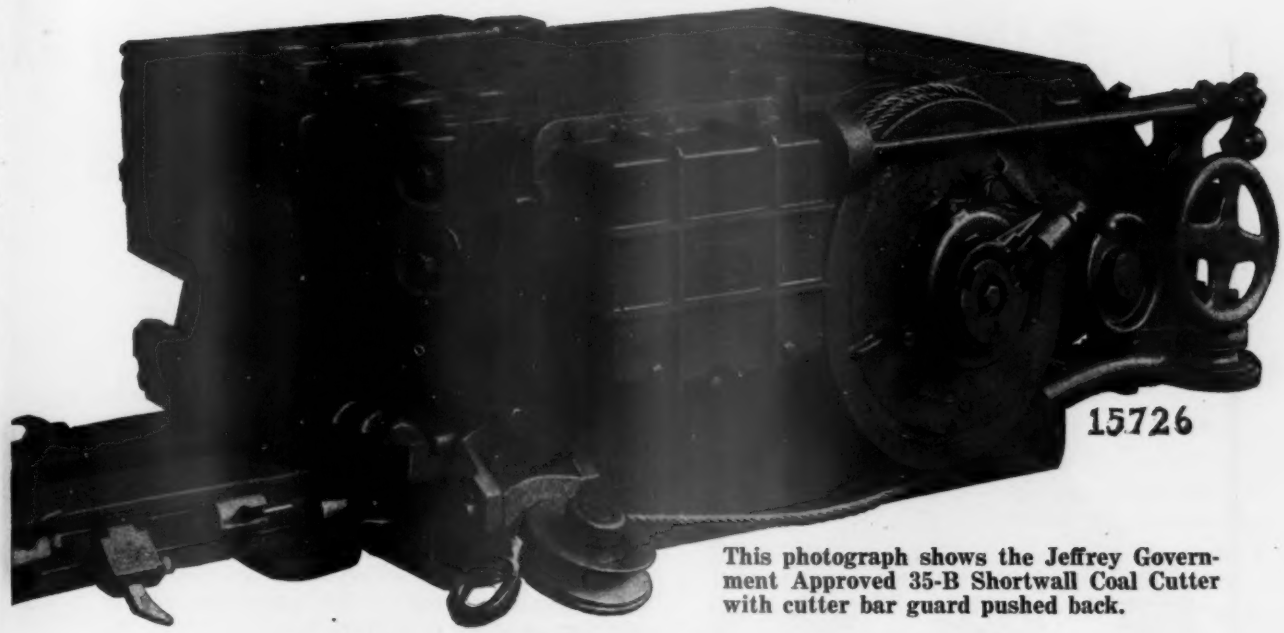
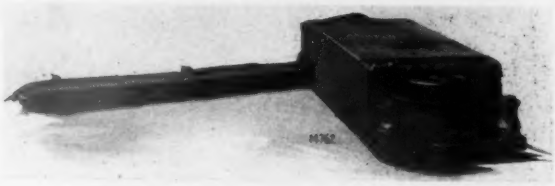
A complete description of the Jeffrey 35-B Shortwall and the other coal cutters shown on opposite page will be sent on request.



This photograph shows the Jeffrey Government Approved 35-B Shortwall Coal Cutter with cutter bar guard pushed back.

Other Jeffrey Coal Cutters

The Jeffrey Arcwall is furnished to cut either top, bottom or center. It is used for both room cutting and slabbing.



The Jeffrey Longwall swings its cutter bar through an arc of 220 degrees, so that it hugs the face. This machine will cut in either direction.

The Shearing Machine gives the face an additional vertical cut. The coal is shot off a free end and gives more large lump. This machine can be equipped with two drills for drilling while cutting.

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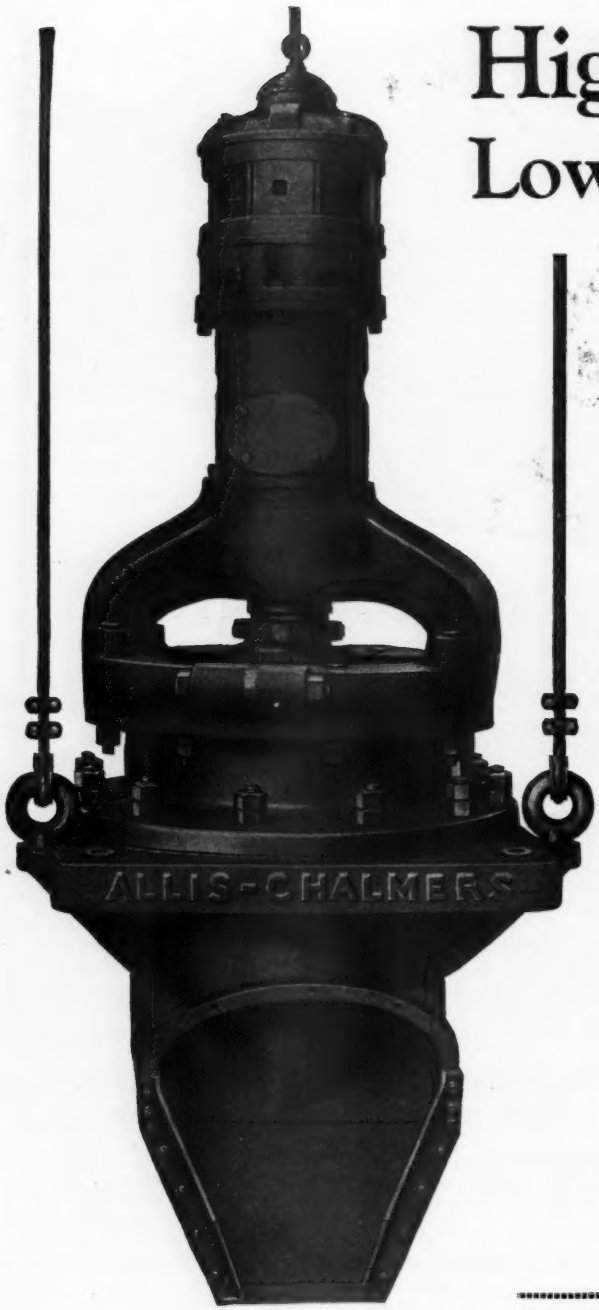

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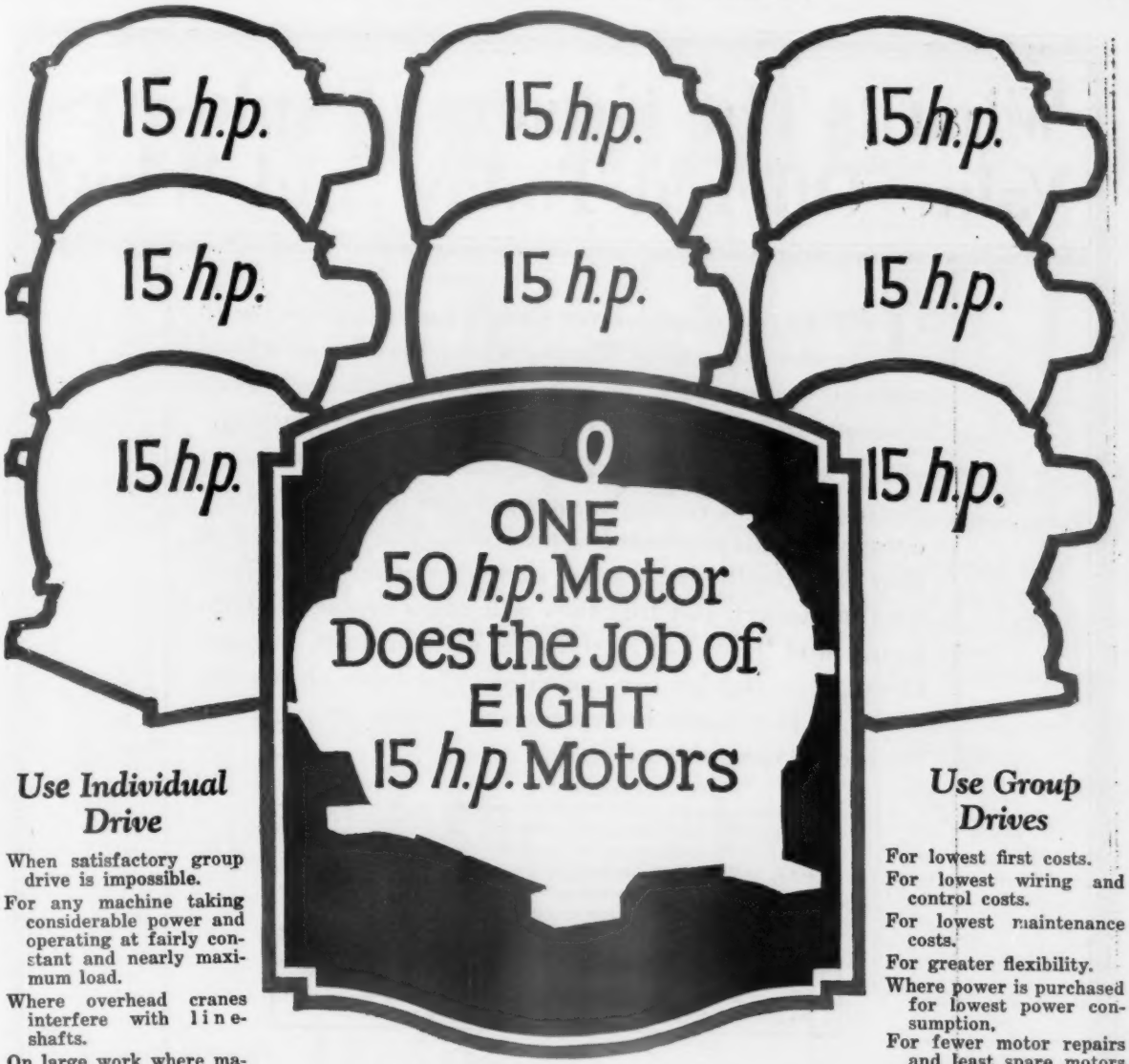

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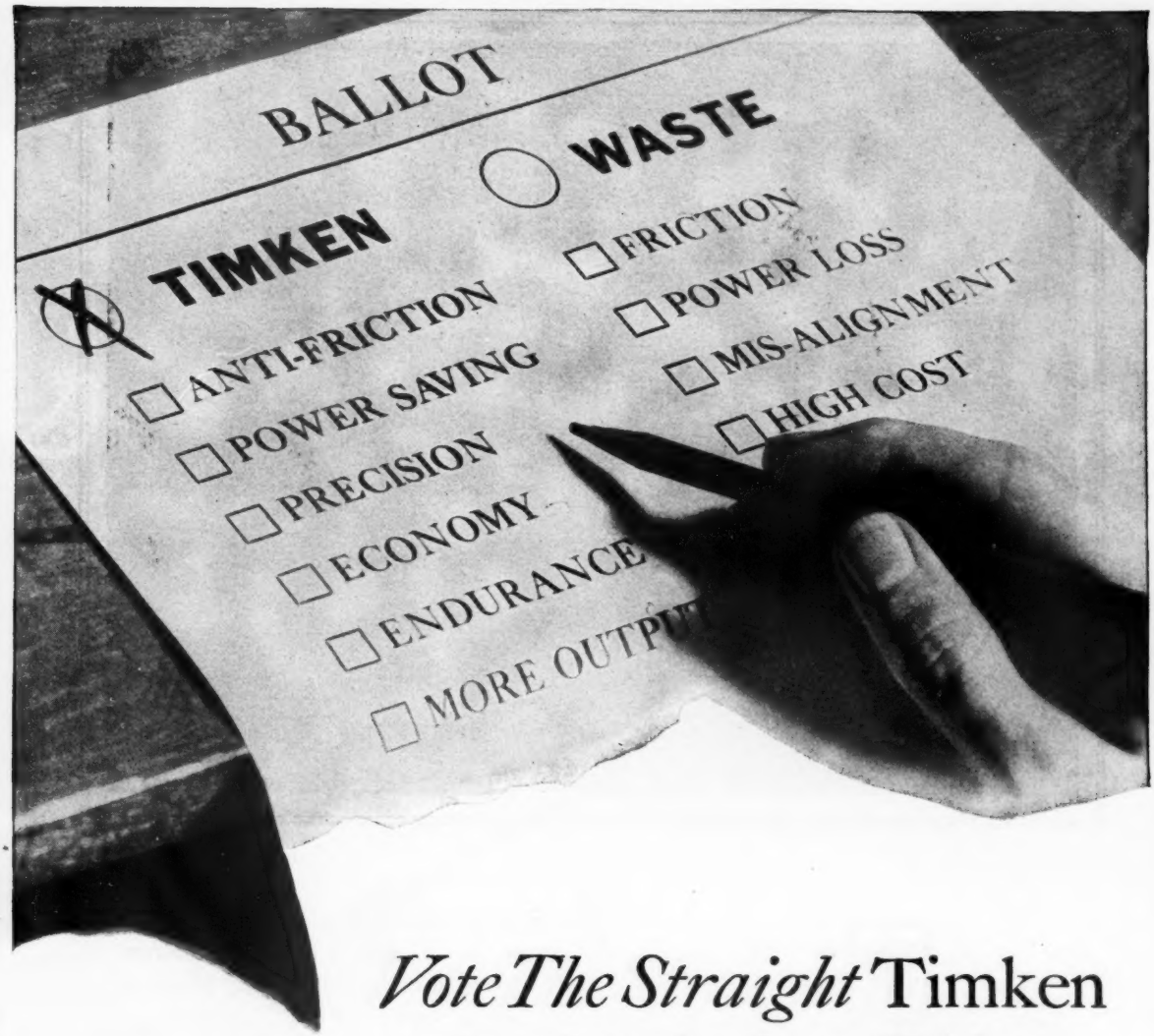

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The
MINING CONGRESS JOURNAL
**A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress**

VOLUME 14 November, 1928 No. 11

Editorials

King Of The Universe

SUCH a title, applied to the mining industry, may at first glance seem ambiguous. But investigation will bring out the fact that mining is entitled to such a sobriquet.

Mining is a generic term. It means almost limitless industry, and is susceptible of infinite division. Starting from scratch, it means Coal, Iron, Copper, Lead, Silver, Zinc, Gold, and that surprising group known as Non-Metallics. But from Coal alone there emanates some 500 industries, each employing thousands of men. Iron is but the raw material for our great Steel industry. Copper enters into a multitude of industries, as does Lead and Zinc. Gold and Silver, aside from being our financial base, contribute to industry in a great measure through the jewelry trade. So far as Non-Metallics are concerned their range is astounding; from cement roads to cosmetics, from lime water for the baby to manganese for steel and from water purification to plate glass.

The mining industry has contributed in gigantic measure to the prosperity of the United States. It furnishes employment to a vast army of workers. According to the Department of Commerce, more than ten million people in this country are making their living from the mining industry. It is estimated that the railroads derive 56.7% of their revenue freight tonnage from products of the mine. The pay roll of the mining industry runs into billions of dollars—dollars that are immediately transferable to other industry in supplying the needs, desires and luxuries of their recipients.

The mineral resources of a nation are its industrial currency for the future.

Knowledge Of An Industry

"KNOWLEDGE is Power" is the sum-up of the financial press in regard to the happy position of copper. This metal has now attained a price level that is a reflection of intelligent direction and control of the product. Closer cooperation of producing companies, coupled with reliable statistics upon all phases of the market, has enabled the industry to recently announce an increase in the wages of their workers.

This announcement connotes two things: That copper is again taking its place in the sun, and that the relation of capital and labor in that industry is on a proper basis of understanding. When the price of copper went down, labor agreed to take a reduction in wages. Now that the price has reached a higher level, operators are sharing the benefits with their workers. The increase brings wages back to the point where they were before the slump, which made the market for copper an uncertain thing.

Certainly the copper industry is a shining example of what can be done in an industry that finds itself faced with a stagnant market, with overproduction rampant, and with a decidedly gloomy outlook. The copper producers, through the Copper and Brass Research Association, through the Copper Institute, and through cooperative discussion of their practical operating problems in the Arizona Chapter of The American Mining Congress, reduced their surplus stocks, studied the possibilities of new markets, and gave serious attention to the working out of metallurgical and operating problems.

Copper is facing a rosy future. World conditions are steadily improving, industry in the United States shows no sign of slacking its forward journey, and the copper industry shows every indication of taking full advantage of the situation through the cooperative, intelligent handling of its product. Many other industries facing the same problems that faced copper such a short time back, may well follow its example.

The Tariff An Issue

IT CAN not be assumed that the tariff will not be considered by the next administration, whether it be Republican or Democratic. The evidence at hand does not indicate that those heretofore opposed to the principles of the high protective tariff have been converted, or that at last the two great parties are in accord on the principles of tariff making.

Many different and contradictory statements of various political leaders can be sifted from the mass of campaign literature of this year. Criticism of certain schedules of the present tariff; opposition to the flexible provision giving the President authority to raise or lower a rate 50 percent; opposition to the Tariff Commission; suggestion that the commission should have greater powers; and a variety of ideas and suggestions, including revision upward, revision downward, and piece-meal revision. The tariff is surely an issue.

With respect to the suggestion of piece-meal revision, that is, doctoring the tariff by singling out certain schedules for revision, presumably downward, American industries will not be lulled into a sense of security. The moment a start is made to tamper with one industry, every other industry would await the outcome with trepidition; and the query "who's next" would throw all industry into a state of uncertainty and suspense. The protective tariff structure can be likened to the delicate framework of a Zeppelin. Every part has its function; and the stress and strain upon every other part, as well as successful operation, depends upon how well each part performs what is expected of it. American industries are interdependent, and the prosperity of one contributes to the prosperity of the others. The suggestion of piece-meal tariff revision certainly makes the tariff an issue.

The fallacious theory of some leaders of political thought that a reduction of the tariff, either generally or in certain schedules, would in turn reduce the cost of living which, in turn, would offset the reduction of American wages that would be made necessary to the extent that American industries are thereby compelled to meet the competition of low-cost, pauper-wage, commodities of foreign manufacture, is being advanced notwithstanding the assertions of other leaders that the tariff is not an issue. As long as any doubt exists about what our future tariff policy is to be, we agree with the *Washington Post* that "no great industry will lay plans for future operations when the greatest uncertainty of all—the uncertainty of prices, wages and deadly competition—is thrust into its calculations."

An Important Announcement

THIS JOURNAL has given many of its pages to spreading the doctrine of mechanization. It has believed in its possibilities; it has advocated its adoption, not alone for coal mining, but for every branch of the mining industry. Therefore the statement which appears in this issue, announcing the five-year program looking to mechanization of the coal mines, finds a responsive chord. We heartily commend the plan, and congratulate The American Mining Congress upon its foresight, and upon its ability to secure the cooperation of the leaders in the coal industry in the campaign.

A National Committee

THE personnel of the National Committee on Mechanized Mining announced by The American Mining Congress is sufficient to insure success. It also indicates the growth of the mechanization idea. The task before it is a tremendous one and promises gigantic results in the way of information that heretofore has been unavailable. Its major purpose is educational. Its creation is the natural outgrowth of the investigation conducted during the past two years to ascertain the extent of the use of loaders, scrapers and conveyors underground. That the demand for it came from the industry itself, is significant. When the survey to be made is complete, information will be available upon every phase of coal production in its relation to mechanization. A national picture will be painted that should place the coal industry before the public in a very much different light. Certainly it will definitely allay that ghost that is eternally bobbing up, because some glory-seeking politician coined it, that "The Coal Industry is the worst functioning industry in the country."

From Hand To Machine Methods

THE coal industry has long realized that it is now passing through a nation-wide evolution from hand to machine methods of production. Experience has shown that this change affects to a greater or less degree all the other mining operations from the cutting at the face to the preparation at the tipple. The National Committee on Mechanized Mining will study all of these problems. It has general chairmen whose duty it will be to give to the industry and the public a real picture of what is being done all over the United States, in every coal producing district, to improve production methods, to develop a cleaner, more economical product, and to eliminate the hazards inherent in the industry.

The creation of the committee represents one of the greatest forward steps in the history of the industry. It should have, and will have, the earnest cooperation of the coal industry.

Purely Mercenary

LOOKING at a subject from an altruistic standpoint is a favorite pastime of most of us, but rarely productive of results. Mechanization is not an altruistic subject. The fact that it will be of great benefit to the coal industry as a whole sounds well, but does not awaken any real desire to test its merits. Just what will mechanization do for my company; just where will we see our ledgers eliminating the red; are the questions that the individual operator asks.

The answer to these questions is found in the cost sheets of those companies already mechanized—who have discovered that increased production per man—decreased maintenance in concentrated workings—simplified haulage—systematized operation underground—have all combined to lower the cost of mining.

And mechanization at once ceases to be an industry problem, and becomes an individual company problem. The far-seeing coal operator knows that mechanization is inevitable. The competition from those few mines already mechanized is beginning to be felt.

What Is To Become Of The Pick-And-Shovel Miner

WHEN any discussion of mechanization takes place, the question is immediately asked, "what is to become of the labor released through the installation of machines?" The mining industry is already faced with that question. What is to become of the miners that will be released through the installation of machinery? The machine bogey was held up before industry by the president of the American Federation of Labor in his Labor-Day address. It is being held up to the public every day in an effort to retard progress, for nothing worth while ever has been gained without at every step meeting opposition of some faction.

More machinery is being used in the production and fabrication of materials today than ever before. More machinery is being used in the production and fabrication of materials in the United States today than in any other country. Yet, where are standards of living as high, or, real wages as great, and jobs as plentiful?

Labor has nothing to fear, and everything to gain, through the adoption of machinery. If we needed anything to bolster up that statement the recent statistics furnished by Dr. Julius Klein, of the Department of Commerce, give some amazing figures concerning the new industries that have absorbed the workers displaced in other industries through mechanization. He points out that 1,125,000 men, formerly factory workers, have found employment since 1920 in driving and ministering to automobiles. The increased demands for educational facilities, a result of more leisure for the working man, has created additional demands for teachers. The $2,000,000,000 invested in the moving-picture industry, with 20,000 moving-picture theaters, has created new jobs for thousands, and aside from the production of films, 125,000 people are engaged in their distribution. And last, but not least, we have today 12,000,000 radio sets—a vast industry, just in its infancy.

What is to become of the pick-and-shovel miner? His burden will be lightened, his opportunities for development will be extended, and the industry he leaves will be given a chance to breathe. Nothing but good can result from such a transition.

Denmark Again

THROUGHOUT the labor world the question of machine vs. hand methods of production is a paramount subject. Labor leaders in their public utterances have declared in favor of mechanization. Secretary of Labor Davis in a recent statement asserted that mechanization is inevitable, and is a great boon to the worker, and that the only thing that needs watching is the period of transition through which we are now passing. John L. Lewis, to come more closely home, has publicly reiterated his sympathy with the desire of the coal mining industry to mechanize.

But apparently this attitude does not extend through the ranks of the United Mine Workers of America. We quote from "A Circular—a message to the miners members of District No. 12, U. M. W. of A.," which was published in the *Harrisburg, Ill., Register*:

"It now becomes our duty to submit a proposed statewide agreement * * * for a referendum vote. * * * This agreement carries a wage of from $5.95 to $10.07 per day. It declares for the establishment of a tonnage rate for conveyors and mechanical devices which is much desired by our membership. It maintains a high wage rate for strip mining. It carries a high wage rate for those working on loading machines, and we believe that this agreement will go far toward, if it does not entirely prevent, the further introduction of loading machines."

This is simply another example of the inability or unwillingness of the miners' organization to face economic and industrial facts, and is another failure on their part to cooperate with those who are trying to place the union mines on a competitive basis with other coal fields.

With the leaders declaring for, and the district officials doing all in their power to defeat mechanization, it would appear that there is at least a wide difference of opinion and that the U. M. W. of A. is, as has been apparent for some time, a house divided against itself.

The Colorado Agreement

MUCH interest is apparent concerning the recently signed agreement between the Rocky Mountain Fuel Company and the United Mine Workers. That it frankly is an experiment goes without saying, but the motives as set forth in the preamble to the agreement are worthy of commendation. Just what the result will be, only time can tell.

The agreement seeks to "substitute reason for violence, confidence for misunderstanding, integrity and good faith for dishonest practices, and a union of effort for the chaos of present economic warfare. To avoid wasteful and needless strikes and lockouts; to establish genuine collective bargaining through free and independent organization; to stabilize employment, production and market; to assure mine workers and operators continuing mutual benefits and consumers a dependable supply of coal at reasonable and uniform prices."

The contract raises the wages of the miners from $6.77 per day to $7 and promises a differential of 23 cents over any non-union scale, provides for a cooperative plan for settling differences, pledges the men to stay at work pending adjustment, provides for a department of medicine and sanitation under joint control, and pledgers workers help to operate the mines more efficiently.

Sounds well, doesn't it? Compare it with the foregoing statement from the Illinois section of the same union. It is an experiment that every coal operator would like to see succeed. The industry individually would like to pay high wages, and to eliminate all of the things that this agreement has for its purpose. It is of course, utopian, but nevertheless its success or failure will be a matter of keen interest.

The Safety Congress

THE Mining Section of the National Safety Council is to be congratulated upon the very helpful program presented during the recent convention of that organization. The sum total of all of the discussion, participated in by mining men from the coal and metal fields, was that the most important element in safety work is the human element, that education of the individual must take precedent, and that all of our talk concerning safety is null if we have failed in selling the idea to the workers themselves. The discussion centered upon ways and means of obtaining the interest and cooperation of the workers, and the proceedings of the meeting should be a valuable acquisition for all those interested in improving the safety record of the mining industry.

Mine Accidents

WHILE the statistics are somewhat belated, coming at the close of 1928 for the year 1927, the United States Bureau of Mines reports that the metal mining industry has improved its 1926 accident record. The report states:

"The death rate for copper mines was substantially the same as in the previous year but the injury rate was reduced 9 percent. The iron mining industry effected a reduction of 14 percent in the injury rate and 42 percent in the death rate. The large reduction in the death rate was mainly due to the fact that the rate for the previous year was abnormally high on account of a single disaster in which 51 lives were lost. Lead and zinc mines in the Mississippi Valley States lowered their fatality rate 13 percent and their injury rate more than 2 percent. A reduction of 7 percent in the injury rate was shown for mines producing gold, silver and miscellaneous metals, but the death rate for this class of mines was 20 percent higher than in 1926. Mines producing non-metallic minerals showed a reduction of 16 percent in the fatality rate and 10 percent in the injury rate."

Reports from the same agency concerning coal accidents show that that industry's record is running neck and neck for the first eight months of 1928 with the same period of 1927, with 1928 a little to the front.

A lively interest in safety methods, competitions, and endless propaganda in favor of the adoption of every safeguard, and the intelligent effort on the part of the industry to eliminate man failure certainly will show real results.

Without Accident

J. G. BRADLEY, President of The American Mining Congress, and also president of the Elk River Coal & Lumber Company, in a recent address before the West Virginia Coal Association, pointed out the large percentage of the coal mines of the State of West Virginia that operated last year without an accident. The record is interesting:

"It will be surprising to many of you and to the general public to know that in the last year there were no fatalities in 72 percent of our coal mines. It seems to me that official records which reveal that 832 coal mines which employed 55,000 men and produced 80,000,000 tons of coal without a fatal accident would be convincing evidence that coal mining is not an unusually hazardous occupation when rules of safety are prescribed, observed and enforced. That is our record in West Virginia in 1927. In 28 percent of our mines, employing 45,000

men, and producing 66,000,000 tons of coal, all of our fatal accidents occurred.

"It is conclusive, in my mind, that if we can produce more than 80,000,000 tons of coal in one year, where more than 55,000 men are employed without a fatal accident, we can reduce the number of fatalities in the 327 mines where all our fatalities occurred. This is our problem and it has been definitely located. We must muster our strength and our resources in the application of measures that will overcome this condition."

While 28 percent is still too large a margin, West Virginia is making strides that set a standard for the industry. The results obtained justify the hope that coal will soon take her place in the front ranks of safe industries.

Cooperative Mining Development

COOPERATIVE mining development of several properties by a single organization as a means of eliminating waste and saving millions of dollars was advocated by J. W. Wade, assistant general manager of the Tintic Standard Mining Company, of Salt Lake City, Utah, in a paper presented to the Western Division of The American Mining Congress, at its Los Angeles meeting. He pointed out that "probably the outstanding waste in every mining district of the West is the duplication of shafts, shaft equipment and underground workings on adjoining properties, where a single entry and its equipment would have been sufficient for the mining operation of the area."

The North Lily Mining Company, the cooperative project under discussion, is a profitable operation because of the arrangement with the Tintic Standard Mining Company, on a cooperative basis in which the Lily Company paid the Tintic Company all expenses for labor and supplies, and paid on a prorated basis for ventilation, machine drills and steel compressors, hoisting, assaying and sampling, indirect operating expense, plant depreciation and administration. In addition, it paid a mining charge of $1.50 above actual cost of operation for each ton of ore mined.

This cooperative arrangement has apparently been successful from the viewpoint of all cooperators. Such a plan offers a solution to other properties similarly situated. It has been tried out in the bituminous coal industry and found profitable. Is it not worth the serious consideration of many companies where high costs are prohibitive?

The Over-Production Curse

OVER-PRODUCTION has been the curse of industry since the World War developed our productive capacity to such an alarming extent. Coal is not the only outstanding example of an industry suffering with an acute case of over-production. For instance, a leading financial newspaper recently carried the statement that the coffin manufacturers are in a sad plight because of over producing their product, and that their wholesale prices have increased 250 percent in the past 25 years, while their retail price has advanced 500 percent. It further states: "The investigator disclosing this situation, said manufacturers have increased far more rapidly than has the number of deaths, with the result that a tremendous and uneconomic overhead is passed on to the ultimate consumer."

Congress must not have heard this. Why not a commission to ascertain the cause, and to recommend relief? It would be more or less in keeping with the open session for investigations if they were to investigate and perhaps seek to show that the medical association is engaged in a conspiracy to limit production.

Conventions

ANNOUNCEMENT by the Board of Directors of the dates for the Thirty-first Annual Convention of The American Mining Congress, December 5-6-7-8, has just been made. The annual conventions of this organization are of real importance. They, like the conventions of the great political parties, declare the "platform for mining." For it is upon the platforms adopted at these conventions that the mining industry proceeds.

Among the subjects announced for consideration are Business in its relation to mining; Mechanization as a means of stabilization; Taxation that is simplified and constructive; and Putting the product to work. Every mining man will be interested in hearing leading industrialists, engineers, bankers and mining men discuss such questions as what is the business trend of the future, and where does mining rank in the procession? What is the world outlook for the consumption of minerals? What recommendations has the mining industry that will simplify and make more constructive the methods of taxation? And who buys mining's product? What are mining's markets? Where does the copper and coal and lead and zinc and iron go?

A program that will interest everyone. A constructive, helpful program, decorative in spots, and vitally important in the planks it advances for the future development of the mining industry.

Selling Mining To Its Friends

IT RARELY occurs to us that we need to be sold on our job. Or that perhaps we are over-sold. But under-sold or over-sold, the result is the same. Ask the coal producer about the metal industry, and he will tell you vaguely that there is a metal mining industry and he presumes it is important. Ask the metal miner about coal, and he will tell you that he has read in the papers about its political difficulties. It is at once our strength and our weakness that we know only the industry in which our personal interest lies.

Whether this is as we should like it or not, it is a fact. And it at once becomes obvious that we can not sell mining to the layman unless we ourselves are sold on it. It has, therefore, been proposed that the mining organizations undertake a campaign to inform mining men concerning this great industry of which they are a part.

This suggestion may sound like one of those "darned schemes of education," which we all hate. But whatever our reaction, there are many very vital facts concerning mining which every one connected with the industry should know. Every mining man should be informed as to what mining stands for in our national life. He should be equipped with certain basic facts about this greatest of industries, in order that he may defend it against those who would destroy it.

We commend the agencies in their program, and we ask our readers to lend their ears, and their minds, and their hands, to the great task of becoming informed.

Water Power And Coal

"HAVE the enthusiastic advocates of public ownership of water power ever checked up its costs as compared with power produced from coal?" pertinently asks the *Wall Street Journal*. They quote interesting statistics furnished by the St. Louis Coal Company, which points out that Muscle Shoals has already cost the Government approximately $150,000,000 and is still unfinished; that the Cahokia Power Plant of the Union Electric Light & Power Company at St. Louis will cost $27,000,000, and that it will produce 30 percent more power than tht best Muscle Shoals can do, and out of the interest alone on the money representing the difference in cost in building the two plants, it can purchase its coal. They also state that the Keokuk Dam, with a capacity of less than one-fourth of Muscle Shoals, which cost $26,000,000 can be undersold by electric power in its own territory profitably produced from coal.

They further state: "These are not conjectures, but facts. They are true of most of the water power in the United States where cheap coal is within easy reach. * * * The cost per ton of coal is decreasing. The efficiency of these plants is increasing, and therefore the cost of production is decreasing. The extraction of by-products from coal in some cases promises to return more from those by-products than the cost of the raw coal, plus the cost of extracting. But there is nothing to be expected in reduced costs from water power."

Public ownership, whether it be of water power, or railroads, or ships, or coal, or anything else within the realm of private enterprise, is a snare and a delusion. It has never demonstrated that it can, without subsidy, compete with or give benefits commensurate with the same project privately controlled.

Effective Competition

ORGANIZE and cooperate was the advice of Charles F. Abbott, American Institute of Steel Construction, to business, in an address before the Rotary Club of Brooklyn. He insists that it is suicidal to run to Congress every time we have a business problem, thus inviting paternalism. He advocates competition as the basic law of our country, and opposes consolidations and mergers, declaring that they are unnecessary when business is permitted a reasonable control of itself.

While we agree with him in most part, we can not accept his view concerning the value of consolidations, especially as applied to the mining industry. Consolidations of mining properties, in our view, will permit of the elimination of many of the evils of the industry. It will tend to eliminate the high-cost, unprofitable mines, and permit those remaining to pay the highest possible wage rates, establish every safeguard and improve the living conditions of the workers, and enable the industry to get its feet upon a profitable road. Where today there exists only here and there a profitable operation, consolidation should make them the rule rather than the exception.

Consolidation will not eliminate competition. It will eliminate, we trust, the cut-throat competition that has been the ruin of the bituminous coal industry, but it will establish competition between districts, instead of between individual companies, and should make for a healthy condition in the industry.

Our Changing Times

EDITORIAL writers, industrial, labor and political leaders have been profuse in their advice to industry. The burden of that advice is the necessity for some change in the anti-trust laws to permit the proper functioning of industry under present day conditions. Economists have long advocated their abandonment. Recently one of their number proposed an "American Institute of Industrial Coördination" to act as a fact-finding agency to solve the problems of unemployment and seasonal prosperity.

Recently Assistant Attorney General William J. Donovan, of the Department of Justice, told coal producers that stabilization of an industry by voluntary action is to be preferred to corrective action by the Government, and urged them to prepare a plan of action, and join in an effort to cure the ills of the coal industry. He stated that agreements as to price of product or quantity of production were prohibited by law, but that no short cut to business stability will serve them. He pledged the cooperation of his department in any effort the operators might put forth. Abram F. Myers, of the Federal Trade Commission, was equally sympathetic and urged the raising of the standards of business through voluntary action.

The whole trend of public thought is for industry and trade regulation through voluntary action, with approval of the Government. However, there is a wide divergence of opinion as to just how this will be brought about. Students of the trust laws insist that they date back over 500 years, are intended to be a part of the common law, and that history will indicate that amendment must always be, to say the least, a very difficult undertaking. At the same time mass production, bringing with it the problems of mass distribution, is demanding a revision of these laws. In many quarters it is asserted that the Sherman law is obsolete.

Out of the welter of discussion, suggestion, demand and threat, there emerges at least one constructive thought—the willingness of those in places of authority to give a sympathetic ear to the needs of industry. Business big and little, is necessary to the maintenance of our prosperity, and political leaders are inclined to foster and encourage both. High sounding phrases such as "a practical method for guaranteeing labor a definite equitable participation in the increased productive efficiency of industry," "profitless prosperity" and the like read well, but can not be made effective or corrected through legislation.

Industry needs less, instead of more legislation. We again present our position in relation to the needs of the mining industry in its marketing and social problems: The amendment to the trust laws to permit the mine operator the same leeway as the miner in solving his problems—that of collective agreement—will go far toward stabilizing the industry. The industry should be given the opportunity to work out its own salvation. Congress can but complicate a muddled situation, unless it repeals instead of enacts legislation.

Cost Control Problems

THE cost control problem of the western miner involves many factors, according to T. O. McGrath, general manager of the Shattuck Denn Mining Corporation, of Arizona. He points out that "the metal miner is not in a position to pass on his increased cost of production due to increases in wages, or other items of expense, by increasing the selling price. Neither can he combine with others to regulate the price

of metals, as the market price of base metals is practically fixed by world prices, due to production coming from all parts of the world. He must rely principally upon his own resourcefulness to wrestle the mineral from Mother Nature, to process and refine it, and to obtain a cost below the price that the world demand may offer him."

He advocated discussion of operating problems and exchange of ideas; the compiling of detailed costs and statistics per operating unit, per ton, and per pound of refined metal for the mine, mill and smelter. He emphasizes the necessity for personal contact, and fixing responsibility and credit. He defines cost control as "the mobilization of all the facts of the business and utilizing them so as to get the lowest possible present cost with the largest possible ultimate profit."

The problems of cost control are inherent in all industry. In mining they are extremely difficult because of the restrictions and natural handicaps.

Elimination of wasteful methods and reduction of costs has largely been responsible for the progress of the mining industry during the last 20 years. The management of today must know accurately its expenditures and costs. Careful analysis is rapidly taking place of the indifference that existed when the ore bodies were rich, and when extraction problems were simpler. The era of the low-grade ore body ushered in the cost control problem. No longer are dividends easily earned. No longer is the metal easily won from the ore. A keener appreciation of cost accounting, a weather eye to the expense side of the ledger, a closer cooperation between workers and management, and a closer affiliation between operators in discussing operating problems, all are tending to reduce the mine managers cost control problem.

Mine Ventilation

AN INTERESTING ventilation problem and its solution, is presented in the paper by J. B. Pullen, ventilation engineer, Phelps Dodge Corporation. The following summary gives, in general, the conditions that must be overcome.

"The most difficult problem is the scattered nature of the operations. Production is obtained from 50 stopes. Underground transportation of the ore requires over 30,000 feet of trackage and the haulage system is fed from over 80 chutes. The nature and occurrence of the ore bodies makes it imperative to carry on an extensive development campaign at all times. Development work is in almost constant progress at 75 different places, of which 25 are in remote sections. Two active mine fires exist in the ventilated area. The mines are warm and humid and it is necessary to have long and irregular passages for the air."

Ventilation is closely associated with safety. As the workings in metal mines become deeper, the problem increases. In coal mines ventilation is a factor that is continuously creating conditions that must be overcome. That the mining industry is meeting and solving these problems is apparent. The problem at the Copper Queen Mine, above referred to has been successfully handled. How this was accomplished is outlined in an article in the September issue of the JOURNAL. Committees are studying ventilation problems, with a view to making recommendations that will help in eliminating accidents. The three great agencies giving this subject serious consideration are the United States Bureau of Mines, the American Institute of Mining and Metallurgical Engineers, and The American Mining Congress. A new problem presents itself in ventilation in so far as coal is concerned through mechanized mining. The committee, whose announcement appears in this issue, has organized a national section to study ventilation as applied to mechanized mining.

A big problem, yes. But being solved through the willingness of the industry to present just such facts as Mr. Pullen has presented, together with full information concerning how the problem is being satisfactorily solved.

National Thrift

THE history of government finances and financing since 1790, as related by Henry Herrick Bond, Assistant Secretary of the Treasury, in his recent address to the Associated Industries of Massachusetts, is tremendously interesting. From a new-born nation, with a total debt of $54,000,000, and a governmental expense of only $507,000 annually, the United States Government has grown to a nation with a debt of over $17,000,000,000, and a governmental expense of over $3,000,000,000 annually. He quotes from a report made by Alexander Hamilton in 1790, the following noteworthy statement: "Persuaded, as the Secretary is, that the proper funding of the present debt will render it a national blessing, he ardently wishes to see it incorporated as a fundamental maxim in the system of public credit in the United States, that the creation of debt should always be accompanied with the means for its extinguishment. This he regards as the true secret for rendering public credit immortal." And he shows how well our Government has adhered to that policy from that time down to the present.

Although this country emerged from the World War with a public debt greater than that which has burdened any country in the history of the world, the rapidity of its curtailment since 1920, the manner of refunding the Liberty Loans to effect enormous savings in interest charges, and the maintenance of a revenue and taxation structure with a base sufficiently broad to withstand the shock of a year of depression, all evidence the ingenuity and thrift, not merely of those guiding the policy of the Treasury Department, but of the people as well. In certain other countries, it appears that the taxation and revenue structure has borne heavily upon the masses—principally labor and agriculture. In this country, agriculture and labor are practically exempt from Federal taxation, and notwithstanding the heavy tax burden, wages have continued to increase. Of course, agriculture has been depressed; but Federal taxation policies have not been a contributing cause for this depression.

During the last eight years, economy in both national and home affairs has been preached and practiced. The process of effecting economies in state and local governments has been slower, but its effects are beginning to be felt; so that now the citizen, his state and local government, and the Federal Government, are cooperating in carrying out policies of economy and thrift necessary to the maintenance of the nation's credit. Only a Republic and a people such as ours can achieve such results.

NEEDS *of* WESTERN METAL MINING INDUSTRY

By CHARLES W. MERRILL *

IT IS my belief that there is not a man present among this earnest gathering of those interested in the mining industry, who has not a deep seated and heartfelt desire that the existing unprecedented welfare and prosperity of the whole mass of American people be maintained not merely through our own generation but through the generations of our children and their children. In the decades to come there can be no question of the keenness of the foreign competition which we are doomed to meet, and in this great international contest that nation which has the best balanced program of development and that broadness of vision in its governmental direction, which recognizes the necessity of a sympathetic attitude toward the upbuilding of such a broad program, will be the nation which will maintain and preserve that welfare of all of its people.

We, of the mining industry, therefore, do not come begging for special favors, nor do we wish for that over-paternalization which this government has, with the best intentions, given to our great sister industry—agriculture, and which has resulted in a great over-production with a consequent fall in price and a reduction in the comfort and welfare of the tillers of our soil. We wish only to point out that a balanced program in which the mineral industry receives proper recognition to an extent which will make possible the development of needed mineral products which will supply requirements and industries not flourishing at present, will add opportunity for those not now enjoying their full proportion of this nation's welfare and prosperity. If, with wise foresight, such development may be brought about, we may avoid one of the perils which at present seems to menace our social welfare. Not only in agriculture are workers finding their jobs falling away through increased mechanization of that particular industry, but also as we progress in the mechanization of other great industries is the same result releasing many skilled workers who must find opportunities for their hands and brains along other lines.

Those in social work are noting with the keenest anxiety the great increase in the ranks of the unemployed, year by year, particularly in recent years from this cause, and does it not, therefore, behoove those charged with the responsibility of our governmental activities—both state and nation—to give earnest and exhaustive heed to the development of new lines of endeavor which will absorb and give opportunity to those who are being released from industry because of our progress in labor saving inventions in many industries?

U. S. Geol. Survey

"What more far-seeing policy could be adopted than for our states and nation to stimulate the unfolding of our mineral possibilities?"

What better field for government activity toward the solution of this great problem can be found than in bringing to light those mineral resources which are still hidden?

What more far-seeing policy could be adopted than for our states and nation to stimulate this through their agencies such as our national and state geological surveys—thus, unfolding of our mineral possibilities? And in this I am not thinking solely of what most of us are probably personally interested; i. e., the precious and non-precious metals, but I am thinking of our non-metallic mineral resources and of processes for their utilization.

What if our states and nation were to double or even triple their allotments for such work? The sums involved would be but a drop in the bucket in proportion to our total expenditures and the results might well be that the slack would be taken up which makes the difference between idleness and discontent with all their evils, and industry and contentment with all their blessings.

But perhaps I am straying into too broad fields because I see I am supposed to talk on the "Needs of the Western Metal Mining Industry," and in particular does the future prosperity of California depend to a very large degree upon the development of her vast stores of mineral wealth to supply and initiate demands of manufacturing and industry.

The industries of California are prominently identified in meeting the requirements of manufactured products of the Pacific Coast region, which comprises a population of approximately 10,000,000. This population is increasing at the rate of about 500,000 annually, resulting in greater requirements of different minerals by the industries of this region, which is destined to become a great industrial center of world trade.

Research, Legislation, Development Of Markets And National Publicity Among Need Of Metal Mining—A Balance Program In Government Affairs Where Mining Receives Proper Recognition Urged

* Chairman Statewide Mineral Committee, California Development Association. Delivered before Western Division, American Mining Congress, Los Angeles, September 10, 1928.

CALIFORNIA'S MINERAL PRODUCTION, 1927

Total value (in round figures)	$366,000,000
Composed of Fuels	281,184,000
Metals	17,615,000
Structural	54,734,000
Industrial	5,235,000
Salines	7,349,000

Petroleum increased in quantity but dropped in price so that total value is less, $261,000,000 against $346,000,000.

Natural gas increased in quantity utilized and value.

All of the metals except quicksilver decreased.

California's greatest advance in the mineral industry during the past twenty years (outside of oil), has been in industrial and structural materials. The eleven cement plants produced in 1927, 14,661,783 barrels of cement valued at $26,474,934 at plant, more than doubled the value of our present output of gold.

The annual output of crushed rock, sand and gravel is $19,000,000; brick and hollow building tile $6,500,000; salines including borates, potash and salt, $7,349,000; and other structural and industrial minerals $6,214,000; or more than $65,000,000, as compared with $17,615,000 for all metals including gold, silver, copper, lead, zinc, quicksilver, antimony, iron, manganese, platinum and tungsten.

Mr. Walter Bradley, state mineralogist, makes the following statement on industrial minerals and salines:

INDUSTRIAL MINERALS

"California has such widespread and varied resources in this group that her position is really unique among the states. The list includes asbestos, barytes, clay, diatomaceous earth, dolomite, feldspar, fuller's earth, gem stones, graphite gypsum, limestone, lithia, mineral paint, mineral water, pumice, pyrites, oil shale, silica, sillimanite-andalusite group, soapstone and talc, strontium, sulphur. The more important of these minerals thus far exploited here, so far as shown by value of the output, are limestone, mineral water, pyrites, pottery clays, diatomaceous earth, gypsum, talc, and dolomite.

SALINES

"The saline group also contains several items of vital interest to the chemical and other manufacturing industries. Here again California is to the fore, having been for many years the sole American producer of borax, likewise a leading world source in that commodity. Common salt has many uses other than culinary, including packing meat, curing fish and hides, dairying, refrigerating, preserving products from deterioration, pottery glazing, enameling, pickle making, salting live stock, and in some chemical industries, as in preparing caustic soda and soda ash. California not only supplies most of its own wants in salt of all grades, but exports a considerable tonnage annually. Sodium carbonates (soda ash and bicarbonate) and sulphate (salt cake) are contributed from certain localities in the desert regions of California. Magnesium chloride and sulphate, also calcium chloride, each have uses which are advancing and which can be taken care of from California sources.

"Of the 58 counties of the state, there is not one but what can or does contribute at least a portion to one or another of the above groups. Some counties contribute to all of them."

STATE-WIDE PROGRAM

The program of the state-wide Mineral Committee is divided into four branches of work, including research, legislation, development of markets and publicity. Each group is in charge of a state-wide chairman, with regional vice chairmen in the different mineral sections of the state, such as Sacramento, Stockton, San Diego, Los Angeles, and San Francisco, thus making it possible to obtain state-wide support on important developments that are necessary to place the mineral industry on a more stable basis. Practically every region of the state has strongly endorsed this plan of cooperative effort, and it is felt that substantial progress will result.

WORK OF STATE-WIDE MINERAL COMMITTEE

(1) *Research.*—Chairman, Theodore J. Hoover, dean, School of Engineering, Stanford University.

(a) County surveys.
(b) Special mineral surveys.
(c) New geological map of California.
(d) More effective coordination with federal agencies, including the United States Bureau of Mines and the United States Geological Survey.

(2) *Legislation.*—Chairman, Wm. E. Colby, attorney for California Metal & Mineral Producers Association, San Francisco.

(a) Codification of state mining laws.
(b) Indiscriminate filing of mining claim in national forests—a remedy for the present indiscriminate filing of claims in the national forests on lands that do not contain minerals in paying quantities, and which are used for other than mining purposes.
(c) A revision of the present state mining law to prevent continuous refiling of claims over a period of years without any location work being done, thereby holding up the development of highly mineralized areas.
(d) National legislation to eliminate the present "high grade" evil.

(3) *Development of Markets.*—Chairman, James M. Hill.

Greater cooperation of purchasing agents, architects, engineers, contractors and manufacturers in a more general use of California minerals.

(4) *State-Wide Publicity.*—Chairman, Frank H. Probert, dean, College of Mining, University of California, Berkeley.

To bring about a great mineral development mindedness on the part of the public in California, on the Pacific coast and throughout the nation by presenting timely articles that will familiarize the public with the situation, thus creating greater confidence and interest in a sound development of the mineral industry.

Finally, an investigation by our Mineral Committee showed that eight different agencies were engaged in various phases of mineral development, each knowing little of what the others were doing. They embrace the following:

Universities in California, State Mining Bureau, California Metal and Mineral Producers Association, American Institute of Mining and Metallurgical Engineers, United States Bureau of Mines, California Branches of American Mining Congress, California Commonwealth Club, California Chambers of Commerce.

These agencies were brought together by the Mineral Committee, and for the past three years have been working in close harmony in support of a sound uniform state-wide plan of mineral development. On our committee, along with these agencies, are representative producers of metallics, cement, clay and rock products, machinery and equipment, the railroads, and other related industries.

This unification in our state has and will prove helpful in bringing about a reasonable recognition of the contribution that a forward-looking and balanced program within the state may accomplish. Whether we, here, locally, can accomplish for California those broad benefits, which I touched upon in the beginning of my address, without organizing politically, remains to be seen. I still have some confidence that we may be able to, but it behooves us all to take a firm stand and to be unceasingly active for aiding research, legislation, development of markets, and state and nation-wide publicity. The initiation of this conference, this sixth annual meeting of the Western Division of the American Mining Congress, with the cooperation of the American Institute of Mining and Metallurgical Engineers, and the State-Wide Mineral Committee of the California Development Association, is in itself a promising symptom of the realization that in the mining industry there exists, at least a potentiality for maintaining that glorious welfare which, for the present at least, puts our nation in the forefront for mass prosperity and happiness.

STABILIZATION *in the* MINING INDUSTRY*

By Robert E. Tally †

Stabilization Is An Adjustment Of Supply To Demand At Prices That Will Make The Mining Industry Attractive, Not Only From Standpoint Of Fair Return On Investment, But With Sufficient Profit To Conduct Research Both As To Methods Of Production And New Ore Bodies.

STABILIZATION has been defined as a common sense adjustment of supply to demand. I presume Webster would take issue with that definition, and that in the true sense of the term, stabilization should be defined as uniformity, and in applying it to the mining industry we might say uniformity in production, consumption and in prices.

That, however, would not be sufficiently broad to cover the aims of the American Mining Congress, and the end which we are seeking. Stabilization as we view it is an adjustment of supply to demand at prices that will make the industry attractive, not only from the standpoint of fair returns on the investment, but with sufficient profits in addition for the research field and the search for new properties, and make the industry in general look attractive for the future. Mining, as a whole, has not been particularly attractive for a few years—we might say since the war. That is not true of all metals and non-metals, but as a whole, I think it is relatively true.

We know difficulties the coal-mining people have had, also the iron and copper mining people, and it is the aim of the Mining Congress to cooperate with the industry and lend their efforts toward improving this situation. Difficulties of this nature might be compared with the subject of medicine. I think when an industry is sick, it is more or less like a sick patient. It is a matter of first determining the cause, and then applying the cure. There is no question but that the cause of the unfavorable condition, or relatively, the unfavorable condition of the industry in recent years, is due primarily to over-production, and when there is over-production, and that production is placed on the market, it quite naturally follows for the price to sag in a way that the returns for the industry are not attractive. We all know that mining, next to agriculture, is the basic industry of the country.

This country would not have forged ahead the way it has were it not for the natural resources which were at our disposal and were it not for the manner in which they have been developed. That condition will not always prevail. Every pound of ore that is taken out of the mine is gone forever. We will continue to find new mines; we will continue to find substitutes for metals. We can develop new methods of finding ore. Great progress will be made in the recovery of the values of ores which today are non-commercial. But looking ahead over a period of years, the welfare of the country demands the greatest of care, as was stated yesterday by Mr. George Otis Smith, in the conservation of those metals, in the elimination of waste, in saving of by-products, and in recovering everything that is in the ores, at the lowest possible cost, in order to make the industry attractive for the future; and that requires the cooperation of the industry as a whole, and also of the United States Government.

This great over-production is due largely to increased demands which were brought about during the war. When the Government needed excess amounts of minerals to carry on the war properly, prices went up out of sight; that encouraged development of new mines and the enlargement of the then existing mines, to additions to the majority existing plants, with the result that many mines in the industry today find themselves in a position that they can not produce economically, or at a profit, except at a rate which if continued by the industry as a whole will result in over-production and low prices. The subject of stabilization, like taxation, has many ramifications, many difficulties to overcome, but greatest is that of cooperation of the members of the industry, and by our Federal Government.

It would be an easy matter if the mines—I might say lead mines, or copper, or zinc—could meet and determine the consumption of their metals and then try to increase the use of their respective metals, and arrive at the production on a basis that would meet that demand. If the mines would work together; if they would cooperate as they should, it would be a relatively easy matter. But we know that the Government, through its trade commission, will not permit any such action, because that would be considered an act in restraint of trade, and would not be permissible.

Personally, I feel the policy of the Government in that respect is not sound. It is a policy which if continued will discourage the development of mining in this country. The Government, however, has its (*Continued on page* 817)

Part of 500 level surface plant, United Verde Mine, Jerome, Ariz.

* Delivered before the Western Division meeting of the American Mining Congress, Los Angeles, Calif., Sept. 13, 1928.

† General Manager, United Verde Copper Co.

OUR JOB

By FRANK H. PROBERT *

APOLOGY for the inelegant title of this paper is perhaps necessary, but to clothe the subject with more pleasing phrase would modify the force of the argument. In the science or art, whichever it is, of modern salesmanship, all manner of devices are used to stimulate the imagination or excite the interest of the apathetic public, and custom condones the offense. Thus we resort to such catch phrases as "When better cars are built," we disturb our cultured equanimity by deliberately misspelling words as "Kream Krust" or our thoughts are directed by the appeal of pleasing pictures of the human form divine, to purchase Palmolive or smoke Camels. To command attention advertisements must forcefully intrude on public consciousness and to be successful they must leave an indelible impression. We of the mining fraternity need to advertise ourselves. As a representative of one of the institutions of higher learning, I might have dignified my subject by the caption "Our professional obligations to the mineral industry," but such headline lacks punch, there is a smugness about it which invites drowsiness and excuses inattention. However, let us not quibble over titles: I like the one I have chosen; it implies that we all have something to do, a purpose, with hope of accomplishment. Our inactivities have been characterized by dilly-dallying and complacency, and perhaps we have been accorded our desserts. It is my desire to arouse in this assembly an appreciation of our job, an allegiance to it, and a united enthusiasm in putting it across. Airing our grievances accomplishes little or nothing, we must build a platform on which we can firmly stand, then by all the ways and means at our command broadcast our program to the people, compel them to listen, and sell them our ideas.

Some may ask, and in all sincerity, what is the mineral industry, what, if anything, is the matter with it, wherein does it need help, and by what prescription can its ills be cured? To touch even the high spots of these queries would require time far beyond the compass of my allotment. I can only attempt to review current opinion on some of the issues, and in doing so I must freely quote and paraphrase the thoughts of others, for no one mind has the capacity to comprehend the full scope of so vast and important an industry as mining.

The mineral industry is the warp and the woof of our modern fabric of life's activities. It is as essential for the maintenance and progress of the human race as is agriculture, more so perhaps. Dr. H. Foster Bain has said "The accumulated wealth of mankind is almost entirely in mineral form."[1] With increasing knowledge of the mineral heritage which nature has so bountifully distributed throughout the earth's crust, the diverse uses to which the products of mines have been put has completely changed our mode of living and habit of thought. Distances have been obliterated, the earth has shrunk so that the peoples on scattered continents are as a unit. Exploitation of mineral resources and expansion of use of fabricated products is not conditioned by population; there is no limit of possibilities of human desire for comfort and convenience, whereas the province of agriculture is limited by the capacity of the people to imbibe and gorge and cover themselves with clothes. Even in these things mining is the servant of the farmer.

When addressing the Mining Congress at its thirtieth annual convention, Washington, D. C., Mr. Hoover, with characteristic succinctness, spoke of the magnitude and importance of the mining industry. He is authority for the statement that 2,000,000 men are engaged in

* Dean, College of Mining, University of California.

[1] H. Foster Bain, "The Third Kingdom," *Geographical Review*, April, 1928.

mining, with five times this number as dependents on them. The value of their products is over $6,000,000,000 annually as raw material, which when changed in form by the manufacturer, increases in value to 15 billion. To accomplish this transformation another 2,000,000 men are employed whose wages again support five times as many. When the fabricated materials finally reach the consumer, their value is estimated at $20,000,000,000, and again an army of men find occupation as agents in transportation and distribution. At this stage the value of mineral products equals approximately that of all agricultural products. The farmer and the miner each contributes from his labor on the land, in wealth, about one-quarter of the national income. Mr. Woodrow Wilson, as President of the United States during the time of the World War, issued a statement reading "To the miner let me say he stands where the farmer does; the work of the world waits on him. If he slacks or fails, armies and statesmen are helpless. He is enlisted in the great service army."

Exploitation of mineral substance has probably more than any other factor, exerted the greatest influence on world conditions. It has sent adventurers forth to the discovery of new lands, it has contributed to the change of temporal power, to the rise and fall of peoples, to the stimulation of industry and the march of progress. Commercial supremacy and national strength are predicated upon the control or possession, and the use of natural resources, of which minerals constitute so large and important a part.

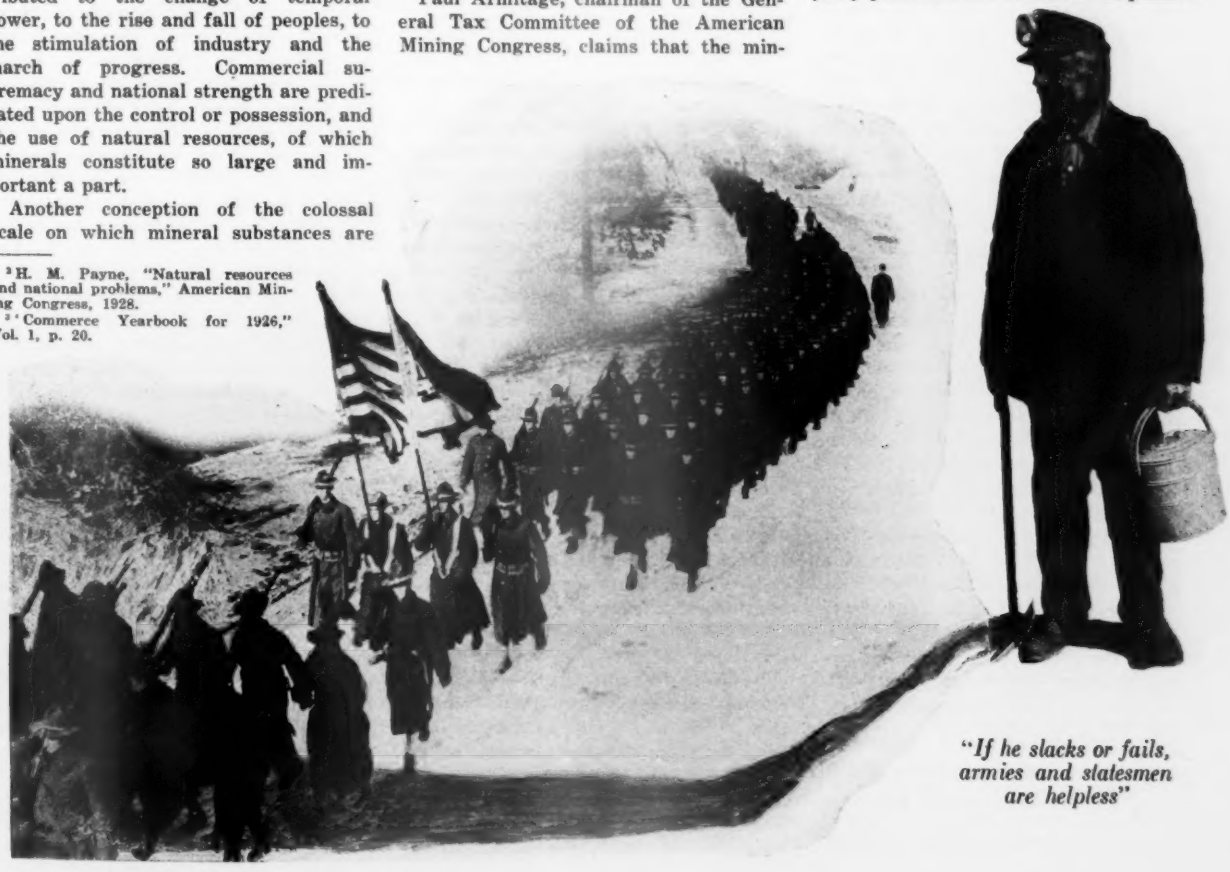
Another conception of the colossal scale on which mineral substances are

An Interesting Presentation Of What The Mining Industry Can Do For Itself—Ponderous Political Procedure Should Be Supplanted By A Public Consciousness Of Mining

worked may be obtained from analysis of transportation statistics. In 1925, 54.4 percent of all revenue freight carried on Class 1 railroads was furnished by mining enterprises; in 1926, 56.7 percent of a total of over one and one-third billion tons. Segregating this total tonnage into commodities the products of farms was 8.36 percent, of animal produce 1.96 percent, and of forests 7.84 percent, or attributable to all phases of agriculture 18.16 percent. Manufactures and miscellaneous accounted for 22.15 percent with merchandise in less than carlots contributing 2.95 percent. Coal made up 38.8 percent, and other minerals 21.92 percent or 56.72 percent from the mines. According to Dr. H. Mace Payne[2] the American steam railroads consume in their operation nearly 30 percent of all coal mined, an equal percentage of the output of fabricated steel, and 11 percent of the petroleum produced.

Paul Armitage, chairman of the General Tax Committee of the American Mining Congress, claims that the mineral industry during the years 1922 to 1926, inclusive, paid Federal and state taxes representing more than 21 percent of its net income. Our industries are characterized by large and increasing use of capital. Taxation figures show that in mining the assets of corporations, current and fixed, were equal to about $10,500 per wage earner employed.[3]

Other pictures of the industry could be drawn using different statistical pencils, each illustrating the influence mining exerts on our economic and social structure. Figures, however, in the hands of a competent statistician can be made to support or disprove any contention, they are wearisome both in discourse and on the printed page, and probably one of the weaknesses of our publicity campaigns for mining is in the unintelligible array of figures and tables we present to impress and usually confound, our audience. The mere bigness of the mineral industry appals; it enters into every public and private enterprise, it performs a national service. We acknowledge its importance and influence without question; we accept it but give it no heed. Can anyone conceive of mining becoming a national issue between political parties as farm relief and prohibition enforcement are before the people today? The mining planks in the party platforms are so similar in phrase-



"If he slacks or fails, armies and statesmen are helpless"

[2] H. M. Payne, "Natural resources and national problems," American Mining Congress, 1928.

[3] "Commerce Yearbook for 1926," Vol. 1, p. 20.

ology and promise, they might have been hewn from the same log. Here the Republicans and Democrats are apparently in agreement, yet in this very unity of opinion the troubles are doubly emphasized. Into the platform built at Kansas City is written "the mining industry has been self-sustaining, but we believe that the Government should make every effort to aid the industry by protection, by removing any restrictions which may be hampering its development, and by increasing technical and economic research investigations which are necessary for its welfare and normal development. The party is anxious, hopeful, and willing to assist in any feasible plan for the stabilization of the coal industry which will work justice to the miners, consumers, and producers." The Democratic party phraseology at Houston, Tex., runs: "Mining has suffered like agriculture. It is the duty of our Government to foster this industry and to remove the restrictions that destroy its prosperity." The extremists meet on common ground and commit themselves to the removal of restrictions hampering mining progress. Here is general acknowledgment that all is not well with the industry. However, in the acceptance speeches of the party nominees for the presidency of the United States neither Secretary Hoover nor Governor Smith thought the matter of sufficient moment to dwell upon it. In England, two years ago, there was a coal strike concerning which I quote from *Finance and Industry:* "The British coal strike is over at last, the great bulk of the miners have returned to work, leaving only isolated districts still on strike. This often happens in mining controversies. The British are counting the cost. The most conservative estimate of the cost of the strike is $1,250,000,000, made by the British Board of Trade. This represents about one-third the English war debt to the United States. This vast sum was wasted, frittered away in a few months." This calamity not only affected England, it disturbed conditions in Germany and in our own country. In deploring conditions abroad we should not be unmindful of the serious consequences of strike and strife in the eastern coal-producing states.

The United States is disturbed today over many questions, not the least of which is the problem of farm relief, one of great complexity and seemingly vital to the peace of mind if not physical well-being of the greater part of the populace. Every thinking citizen, and many who allow others to think for them, will join in the task of satisfactorily solving this intricate problem by recording a vote at the polls, yet the question may fairly be asked, why this public unrest over the condition of the farmer? I have said elsewhere:[4] "Carrots and corn cater to our appetites, whereas colloids and catalysers are beyond the ken of most citizens."

The U. S. Government appropriates $33 for the advancement of agriculture to every $1 given to mining, yet the *Engineering and Mining Journal* quotes Mr. Hoover as saying: "In its raw material stage the mineral industry pays in direct taxes to the Government more than five times the amount levied upon all other raw materials industries put together."[5] In the last quarter century, with all federal and state aid and assistance given to it, agriculture has increased production 47 percent. Mineral production has increased 248 percent in the same period.

"To inform the people; to sell them the idea; to make them realize that mining is their business, is 'Our Job.'"

In a recent review of the metal mining industry of the American continent, A. B. Farsons presents some illuminating data[6] showing the invested capital in copper, lead, zinc, gold and silver mines to be one and one-quarter billion dollars operating at a net profit (before depletion) of $127,659,000 and paying dividends and interest of $108,651,000. Furthermore, he shows that the ratio of earnings to capital in all the mining industry during 1927 was 8.9 percent, whereas in all producing industries other than mining the figure is 8 percent. In coal and coke the ratio is but 2.1, for oil 5.7, iron and steel 4.9, copper 7.8, gold and silver 16.5, and lead and zinc 19.6 percent. Attractive as these ratios are at first sight, excepting coal, when depletion is properly included, the status is not so satisfactory. The hazards of mining ventures must not be overlooked, the vagaries of mineral occurrence, the fluctuating markets, the inherent risks, the exorbitant taxation, the legislative restrictions and prescriptions are factors difficult to evaluate. Political busybodies, obsolete and unrepealed statutes, and governmental interference contribute to the precariousness of mining enterprise. We are confronted with a dilemma of over production and competition in the working of different mineral substances. Each mineral seems to have troubles peculiarly its own. Earnest effort is made to organize relief only to lead into a stone wall of government or legislative objection. What is current opinion on the present-day attitude of government toward industry as a whole and mining in particular? Public opinion is largely molded by the press, and newspapers are as often as not misleading. We must seek the impressions of experienced men, and in doing so confusion rather than clarification of ideas results. In the prefatory remarks of the Commerce Yearbook for 1926, Dr. Klein, Director of the Bureau of Foreign and Domestic Commerce, writes: "One of the most important facts in regard to American industry is its increasing efficiency. During the first quarter of the present century the number of wage-earners in the factories increased about 88 percent, while their quantity output increased 178 percent. As a result the production per wage-earner in 1925 was 48 percent greater than in 1899. Even in the short period of 1919 to 1925 the output per wage-earner in our factories increased 40 percent as a consequence of the greater efficiency of the wage-earners themselves, improved management, more scientific methods and waste elimination, the greater use of machinery and other forms of capital as an aid to human effort." In spite of this citation of accomplishment, we are nevertheless mindful of oppressive political and legislative influence clogging the wheels of industry which can not long be tolerated. The economic development of our resources is restrained by incompetent laws. Even at the seat of our government in Washington, D. C., the ponderousness of political procedure is appalling. We are apparently ruled by commissions, investigating committees or other inquisitive groups charged with the responsibility of fact or fault finding with accompanying recommendations to higher authority for subsequent consideration and still more remote action. It has been facetiously remarked that the Congress of the United States opens with prayer and closes with an investigation, but in very truth, in the last two years committees have conducted 48 major inquiries with as many more pending. What does Mr. Hoover say of this? In his acceptance speech we heard, "One of the greatest difficulties of business with government is the multitude of unnecessary contacts with government bureaus, the uncertainty and inconsistancy of government policies. By scientific research government can promote invention and improvement in methods. By economic research and statistical service it can promote the elimination of waste and contribute to stability in production and distribution. The test of business is not in its size—the test is whether there is honest competition, whether there is freedom from domination, whether there is integrity and usefulness of purpose." Too many useless contacts, too much uncertainty, too much inconsistency of gov-

[4] F. H. Probert, "Science, Engineering and Industry," Engineering Council of Utah, 1928.

[5] *Engineering and Mining Journal*, Vol. 124, p. 989.

[6] *Engineering and Mining Journal*, Vol. 125, pp. 844-849.

ernment policies. This condemnation from one of the greatest engineers and economists of all times. We are obsessed by inquisition; we are confused by the number of laws upon the statute book, by the ambiguity of their phraseology and susceptibility to varied interpretation.

To solve the problem of production control of petroleum a committee of nine learned men met, studied the situation in all its aspects and reported, "We recommend federal legislation which shall unequivocally declare that agreements for cooperative development and operation of single oil pools are not in violation of the federal anti-trust laws, and permit, under suitable safeguards, the making in times of overproduction, of agreements between oil producers for the curtailment of production. Similar legislation should be enacted by the several oil-producing states."

Mr. James Veasey, chairman of Mineral Committee, American Bar Association, in an address before that body at Buffalo, N. Y.,[7] [8] and again at the Mid-Continent Oil and Gas Association meeting at Tulsa, Okla., convincingly analyzed the deplorable overproduction condition in the oil industry and pointed to logical procedure for relief. He said, "Orderly production upon the basis of a stabilized price, fair alike to the producer and consumer, is the modern economic ideal. This is the principle for which the farmer, the bituminous coal miner, the textile industries, and other enterprises plagued by overproduction and its attendant evils, are now so vigorously contending." "When we take into account our rapidly growing population, the mighty expansion of our business enterprises, the vast aggregation of capital necessary under our economic system, the large scale production which everywhere now characterizes all industrial effort, we must realize that the only form of government which could possibly endure would be one sufficiently elastic to meet changing conditions."

The Senate Interstate Commerce Committee has held protracted meetings trying to get to the bottom of the pit of despair that engulfs the bituminous coal industry. Whether it accomplished anything remains to be seen, although if straws indicate the direction of the wind, superintegration of producing and marketing units may be anticipated. The fuel consumption in the United States demands an annual production of half a billion tons of bituminous coal or about one and one-half million tons a day. This is essential, and to insure it there must be some unified operation and control. The present economic crisis in coal mining is the most critical and insidious that has confronted us. Colossal combines under permissive legislation is an apparent necessity, but to meet the issue the banking interests must be drafted into service. We have an impressive array of facts in our prospectus on coal. Who will underwrite the needed finance? The wary banker must be convinced as to future trends. Convincing argument wherein the risk will be acceptable to the banker is hard to adduce. The problem is very much involved. I commend to your thoughtful reading A. T. Shurick's paper, "The Coal Dilemma and the Banker."[9]

The remarks of Dr. George Otis Smith, of the U. S. Geological Survey, in a recent address[10] are pertinent to this situation. He says: "The principle of legalized cooperation in aid of needed self-control should be extended to all branches of the mineral industry."

It has been suggested that one method of controlling overproduction of minerals is for the government to exercise its prerogative to grant or deny the privilege to prospect or exploit the reserved mineral lands still within its jurisdiction. All lands coming within the purview of the leasing laws, coal, phosphate, oil and saline lands, might be withheld from the public according to the trend of production. It is unlikely that such action would have any immediate remedial effect; the industry is already sick from overproduction and cut-throat competition.

We note a fearless forward step on the part of copper, silver, lead, zinc and iron producers in the organization of associations, institutes and other groups, having for their purpose control of production and marketing. The cartel system of Germany was successful before the war; it has been revived and is expanding rapidly throughout western Europe.

There is apparent need of insistent demand for clarification of other issues facing mining activity. Brief reference may here be made to the much discussed immigration laws. The Box bill, urging restriction of immigration from Mexico, is now before the House Immigration Committee. Pity the poor peon; he is branded as unclean, unhealthy, a menace to public health. Can not these matters be discussed in a dispassionate manner? Legislators might view the situation with common sense motives, uninfluenced by prejudice. One of our greatest faults is that we make our laws too comprehensive and inelastic. The Mexican inquiry vitally affects the mining communities of the Southwest as it does the fruit-picking industry of California and railroad construction and maintenance work of the Western States. Our Secretary of State, Mr. Kellogg, before the Senate Committee on Immigration, in no unmistakable terms forcefully argued against increasing quota restrictions. Two-thirds of all our foreign investments are in North and South America.

We have heard much discussion of the tax laws during the last 15 years, a disagreeable subject at any time. I have waded through voluminous literature on the subject, the original, the revised, the amended texts of the law, even that of May 29, 1928, criticisms, expositions and elucidations without end, and the more I learn the less I know of the subject. The law is so involved that few people can grasp its full meaning, with all the dips, spurs, and angles. It is probably difficult to express in simple phrases the complexity of the law, but an effort should be made to clear it of ambiguities, substantive exceptions and qualifications if such things can be made intelligible to tax-paying citizens. Here, as in other phases of mining work, simplification may result in conserving time, temper and money. Mr. Charles D. Hamel, counsel to the Joint Congressional Committee on Internal Revenue Taxation, calls attention to the need of simpler basic policies. He says: "General rules are obscured by numerous exceptions and qualifications and complicated rules of law are involved in various provisions. We need more of the qualities of the common law in our income tax law. There is an unavoidable conflict between certainty and justice, on one hand, and simplicity on the other." As opposed to all this it is a remarkable achievement on the part of those auditing the tax returns that the work of the bureau will be current on December 31 of this year. An average of 30,000 cases a year referred to the Natural Resource Division are disposed of. The Mining Sub-Section handles from 10,000 to 15,000 cases annually. From the dollars and cents data presented by Mr. W. T. Cardwell it can easily be shown that for the years 1917 to 1925, inclusive, within which period the corporations of the country filed 3,320,504 returns, the total income tax paid by all corporations filing affidavits represented 17.4 percent of the net income. One hundred fifty thousand four hundred and ninety-one mining companies are included in this group and paid income taxes to the extent of 21.26 percent of their net income, thus contributing 6.52 percent of the total income tax paid the Federal government. Domestic taxes must also be paid. In the years 1918 to 1921 the domestic taxes paid by mining companies increased from 1.26 percent of gross income to 2.23 percent, whereas for all other industries the increment was from 0.94 to 1.59 percent.

In this synopsis of existing and proposed legislation that perplexes the land owner, mine operator, and government officials I am not seeking to mold public

[7] *Oil and Gas Journal*, September 1, 1927, p. 32.

[8] *Oil and Gas Journal*, October 6, 1927, p. 32.

[9] Technical Publication 114, American Institute of Mining and Metallurgical Engineers, June, 1928.

[10] G. O. Smith, "Brakes for the mineral industry," Mining and Metallurgy, Vol. 9, p. 347.

opinion for or against. These matters are before properly constituted tribunals for discussion. All that I have mentioned have far-reaching consequences, striking perhaps at the vitals of the concepts around which our government has developed. We need not be apprehensive of quick decisions for we have abundant evidence that legislative inquiry and judicial procedure progress slowly. We must, nevertheless, give thought to these issues, and it is part of "our job" to work constructively upon them.

Thus far I have attempted to present to you some of the many conditions that disturb the mineral industry, matters of importance deserving of our calm, careful, and confident deliberation. *Laissez faire* must give place to the best possible. Destructive criticism without constructive suggestion is of no avail. Let us outline our job. Solution, it seems to me, lies in two directions, education and investigation. Governor Smith, in his acceptance address, remarked that "Governmental policy should spring from the deliberate action of an informed electorate." Our legislative bodies are chosen by the masses to carry out the will of the people. Here, then, is the point of beginning, the commonalty, *hoc genus omne*. The public mind must be enlightened, stimulated and brought to a receptive mood for the assimilation of sound ideas, otherwise they fail to register. First of all we must interest our citizenry at least to the point of curiosity and inquiry. Wherein mining contributes to the making of a loaf of bread, a diamond ring or an automobile, is a much more pleasing theme than natural resources and national strength. It has popular appeal; it excites the imagination. Thousands of dollars have been spent in the preparation of educational films. Works of art, picturesquely perfect, technologically true. They have their value as a means of transmitting knowledge but they do not amuse, and women after a daily round of domestic duties, or men fatigued by business cares, are not satisfied by such exhibitions, yet it is they who visit the voting booths, millions of them. "Chesterfields—they satisfy." Is it the excellence of the tobacco, the delicacy of the blending, or the billboards that sell the cigarettes? Why not write a popular scenario around the mining industry, with all its romance, its glamor, its influence and its magnitude: have the substance there, of course, but garnish the dish, make it look inviting, serve it properly, then invite people to the feast. How many times during the day are we confronted with or dependent upon the products of the mines? Write the story, then illustrate it. Our first job is to arouse a public consciousness in mining; the electorate must be informed in mining as in farming.

In our public schools and colleges to what extent is the importance of mining emphasized in tracing the history of the races? Many of the classic myths deify the prospector. This world of ours has progressed only in so far as the courageous few, impelled to adventurous action by the indefinable urge to wrest from the earth her treasure and limitless power, have by genius or lucky chance first wielded the pick, then planted the flag. Themistocles established the hegemony of Athens by his strategy following the battle of Thermopylae in precipitating the great naval battle of Salamis, which battle was financed by federal taxes imposed upon the silver mines of Laurium. The revolutionary war which in 1813 created Mexico was financed with the bullion mined from the Veta Madre and stolen by Miguel Hidalgo from the storehouse of Guanajuato. The hegira following the discovery of gold at Bendigo precipitated Australia into nationhood. The contribution of California gold following the days of '49 had a profound effect on the economic, social and political structure of the United States. What caused the Franco-Prussian war—a war of blood and iron, as Bismarck said, and what prize did Germany claim? Think of Alsace and Lorraine. The Rand of South Africa had much to do with the Boer war. The strategy of minerals was particularly emphasized throughout the World War, the rush through Belgium to the coal fields, the drive through northeastern France to the iron mines of the Meuse, the siege of Verdun, the redrawing of international boundaries at Versailles, the plebiscite of the Saar and Poland. The attitude of Mexico toward the United States has been changed greatly since the development of Tampico and Monterrey oil fields. The oil of the kingdom of Iraq, when that country was transferred to British sovereignty almost precipitated war. We must direct the thoughts of the youth of the land along these lines, for they, too, will shortly select the solons.

Have we examined the possibility of securing the support of the press, in magazines, newspapers, and books, aside from technical publications? Marcosson's series of articles, "The Deluge of Oil," in the *Saturday Evening Post*, beginning last December, were read with interest by hundreds of thousands of people, as was his book, "The Black Golconda," descriptive of the romance of petroleum and dedicated to the wildcatters whose faith and courage made the American oil empire possible. Bret Harte stories will keep fresh the pioneer days of California as will Mark Twain's "Roughing It," the memory of the Comstock. Roy Service never fails to thrill us in his "Spell of the Yukon," but it would be difficult to fill a 5-ft. shelf with such books even though we included Curle's "This World of Ours" and "The Shaddow Show," McCarthy's "Incidents" and "Further Incidents in the Life of an Engineer" (2 vols.), and Rickard's several charming volumes.

Why not take advantage of the opportunity of advertising in the periodic reports to which stockholders are entitled? A. W. Allen, in an editorial in the *Engineering and Mining Journal*, May 12, 1928, suggests that public interest might be stirred if in addition to the dry-as-dust statistical summaries of operating details and balance sheets, data were conspicuously presented concerning railroad revenues derived by mining activity, the percentage of the county and state taxes contributed by the company, the money spent in wages, the number of men employed, their dependents, their influence and force in the community life, the goods they consume; comment on and comparison with other industries. Mr. W. H. Lindsey, past president of The American Mining Congress, said at one of the meetings: "We are not concerned with the production of this or that commodity, but with the larger aspects of mining as it fits into the great national problems of transportation, taxation, power distribution, labor, immigration; the economic development of national wealth, its distribution and utilization; the internationalism of minerals." However, the public must be shown.

We have a few loyal, ardent advocates of our cause whose voices are repeatedly raised in our behalf in congressional halls, the apostles of mining, teaching and spreading its gospel. In the front rank stands our doughty general, Mr. James F. Callbreath, organizer of The American Mining Congress and for over 30 years its efficient, indefatigable secretary. With all due regard to other officials, Callbreath is the Congress.

Progress of the mineral industry is attributable to the advance in educational standards and scientific research. The Government maintains many bureaus directly and indirectly concerned with natural resources, but the Geological Survey and Bureau of Mines serve the mining interests, the one directing search for and understanding of ore and non-metallic deposits, the other, as Director Turner says, "devoted to the conservation of life and health of millions of miners, and smelter men, and to the efficient production and utilization of the minerals which these men labor to exploit for the comfort and welfare of mankind." Both are functioning well; both are hampered by lack of funds. They deserve support. The Chamber of Commerce of the United States resolved at its last annual convention "to call the attention of Congress and other departments of our Government to the manifest inadequacy of the appropriations for proper, helpful research activities of the Geological Sur-

vey and Bureau of Mines." We applaud the persistent efforts of Senator Oddie, chairman of the Senate Committee on Mines and Mining, to help these undernourished offsprings of the Department of Commerce, as we acclaim him for his devotion to our cause.

It is gratifying to know that the Survey has over 40 scientifically trained men now in the field, determining the character of land, studying mineral districts, and otherwise aiding the industry. The accomplishments of the Bureau of Mines are known to all here present, but is the public at large informed? I can not catalogue them; I will mention but a few. In the fiscal year ending June 30, 1927, first-aid training was given by the Safety Division of 83 men to 37,918 people, and mine rescue instruction to 2,961; this in 581 mining communities in 40 states and Alaska. The Bureau men participated as principals in 69 contests in which 6,150 men competed in 21 states. Investigations were made of 41 mine explosions, fires, cave-ins and floods. Mr. Coghill's work in the Tri-State district has revolutionized practices and rejuvenated the zinc industry of that section. Mr. Crane's investigations at Birmingham, Ala., and in the Upper Peninsula of Michigan have been invaluable to the iron and copper mines. The results of the smelter smoke inquiry created a vast fertilizer industry in many parts of the country. Mr. A. W. Fahrenwald's work on the native copper ores of Lake Superior promises to eclipse anything accomplished in ore-dressing in recent years. It will result in an additional saving of from 2¼ to 4 pounds of copper per ton of rock treated. This saving is absolute. Cleaner concentrates will be available, less slag produced, smelting costs lowered, smaller mills will do the work and operations speeded up. Based on the 1927 tonnage mined, a saving is predicted for the big mines for the North and South lodes of over one and a half million dollars, available as additional dividends. This on the added copper production regardless of other economies. The Quincy mine is now considering the application of the process to the treatment of thirty million tons of tailing in Torch Lake, figuring that 188 million pounds of copper are now recoverable which would yield over fourteen million dollars net. Many other instances could be cited of the great work accomplished by the Bureau of Mines. I think I have made my point. It is our job to encourage these two agencies by insisting upon adequate financial appropriations for the continuance and expansion of their useful work.

The California State Mining Bureau appeals to the legislature for a paltry sixty-five or seventy thousand dollars a year when our annual output of mineral substance exceeds in value $523,000,000. California ranks third as a mineral producing state in the Union.

There are a thousand and one research and investigative problems pertaining to the mineral industry awaiting solution and, as they are solved, greater revenues will be forthcoming, new industries will be started, old ones revived or speeded up, new communities will develop and remunerative employment offered to many men.

"Can not these matters be discussed in a dispassionate manner, uninfluenced by prejudice?"

A public consciousness and interest must be aroused in the mineral industry as it ministers to personal and national peace, progress and prosperity. Government policy, whether communal, state or Federal, should spring from the deliberate action of an informed electorate. To inform the people, to sell them the idea, to make them realize that mining is their business as it is ours, this is "our job." I ask you to go to it with enthusiasm.

STABILIZATION in MINING INDUSTRY
(*From page* 811)

side of this case, for, if the industry were permitted to collectively curtail production, they might go too far and curtail it in a way that would be in restraint of trade; that it would stifle competition, which would raise prices to an extent injurious to the country as a whole.

That, however, can also be overcome, because, it is a case of "survival of the fittest," and if prices were permitted to go too high, the consumer would look for some substitute rather than pay those prices. The real cure for over-production is curtailment in accordance with demand, and the cooperation of the individual producers and the cooperation of the Government. The only way this over-production can now be remedied, is by the individual producer. Each individual producer has the inherent right to produce as he sees fit. He can not, however, meet collectively with the other producers and collectively curtail. The only solution at this time is individual action in accordance with demand, and sooner or later the individual producers will realize that situation and produce as they think wise for the protection of their own interests.

Efforts, however, are being continually made through the Mining Congress to have the Government relax and take a broader view of this subject of curtailment or stabilization. While some progress is being made, it has been quite slow. The Government has relaxed quite a little in the last four or five years, and we believe that the situation will be gradually changed; but the greatest help now to be given to stabilization is by the individual producers who will make a study of market conditions and act accordingly.

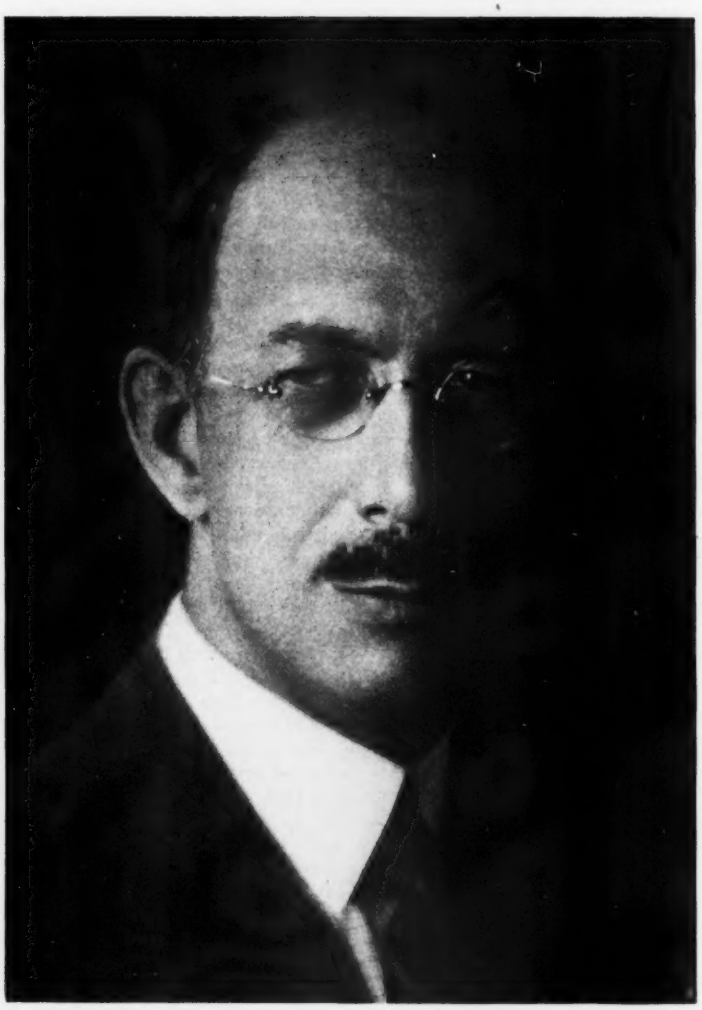
The mines have done a great deal in the way of reducing costs to meet the lower metal prices. They have done a great deal in research departments, particularly in metallurgy, in getting more out of the ore than was heretofore possible. And there has been great progress made, due to high recovery of ores due to improved metallurgical practice; and the fact that mining has been in an unhealthy condition during recent years has made it bad, not only for investors but those employed in the mining industry. Prices have been such that the industry has been unable to pay high wages, with the result that the wages paid by the mining industry are not comparable with some of the other industries; and it is of great importance to improve the situation not only from the standpoint of the investor but from the standpoint of the wage worker and the communities as well.

SAMPLING AND BENEFICIATION OF MANGANESE ORES

Laboratory work on the beneficiation of manganese ores being conducted at the Mississippi Valley Experiment Station of the Bureau of Mines has brought out some facts of interest to the metallurgist. On rhodochrosite samples from the Butte, Mont., district thus far tested, flotation, gravity concentration and magnetic separation processes have been tried. Flotation is very promising. Good separations have been made between rhodochrosite and quartz by this method.

Further details will be given in the report to be issued in the near future by the Bureau of Mines.

NATIONAL COMMITTEE



A MERICAN MINING CON
industry-wide committee to anized mining — National and Information To Be Made To Coal

L. E. Young, National Chairman

IN ANNOUNCING a five-year program to conduct a nation-wide survey into the developments and possibilities in coal mine mechanization, the American Mining Congress takes a great step forward in its effort to serve the coal industry. Safety, efficiency and conservation have long been the keynotes in the work of the organization, and the present work is a direct outgrowth of its work in connection with efficient, and economical coal production. For the past five years this organization has sponsored the national conventions of practical coal operating men in conjunction with the exposition of mining machinery, where the entire time of the convention is devoted to a discussion of practical operating problems.

Believing that the coal industry may reach the high production standards attained by other industries through the adoption of mechanical methods of production, the American Mining Congress has created an industry-wide organization, to be known as a National Committee on Mechanized Mining. The fact that it is sponsoring the work of the committee in a great measure assures the success of the

D. A. Thomas, Alabama

J. G. Puterbaugh, Arkansas and Oklahoma

D. A. Stout, Colorado and New Mexico

L. D. Smith, Illinois

STATE CHAIRMEN

on MECHANIZED MINING

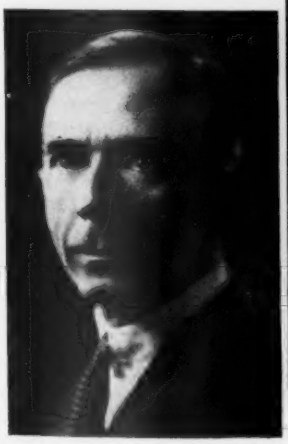
GRESS announces creation of study developments in mech- State Chairmen announced — Available Of Great Interest Producers

J. D. Zook, National Vice Chairman

plan. Equally the men who have accepted the chairmenships, as announced herein, assure the highest possible results. Dr. L. E. Young, vice president, Pittsburgh Coal Company, Pittsburgh, Pa., has accepted the national chairmanship of the committee. Dr. Young has long been an ardent advocate of the advantages of mechanization as applied to coal production. He has been chairman of the Mining and Loading Section of the National Standardization Division of the American Mining Congress for several years, and as such sponsored the first Year Book on Coal Mine Mechanization, published last May. In an address before the Annual Convention of Practical Coal Operating Men, at Cincinnati, Ohio, this year, Dr. Young pointed out five specific factors entering into coal mine mechanization. These are:

(1) The progress that is being made in increasing the average daily tonnage loaded by machines in mines that have been mechanized for some time. What were considered record daily tonnages last year are average tonnages today.

David Ingle, Indiana



Ezra Van Horn, Ohio

W. L. Affelder, Pennsylvania (Western)

E. J. Newbaker, Pennsylvania (Central)

STATE CHAIRMEN

J. B. Warriner, Pennsylvania (Anthracite)

Center: D. D. Muir, Utah

M. L. Garvey, West Virginia (Southern)

(2) The increasing number of mines that have been mechanized completely.

(3) Most of the mechanical loading devices have been installed in old mines and there have been few new mines opened and equipped with loading machines. It will be interesting to note (a) the time required to open and bring to full production a mine that is to be completely mechanized, (b) the capital required to bring the mine to a stated daily output, and (c) the cost per ton that can be secured when the operation is not burdened with the cost of upkeep of a mine of the old type laid out for hand loading.

(4) As the result of mechanization, substantial progress has been made in the reduction of personal injuries; one Illinois superintendent has reported that accidents have been reduced 50 percent.

(5) As a result of the introduction of loading machines, there has been in many mines a reorganization and modernization of face preparation, haulage, and the management of underground personnel.

Edward Bottomley, Wyoming and Montana

F. R. Lyon, West Virginia (Northern) and Maryland

STATE CHAIRMEN

Mr. J. D. Zook, president and chief commissioner, Illinois Coal Operators Labor Association, who has accepted the national vice chairmanship, has long been identified with the work of The American Mining Congress, and is a recognized leader among coal men. All of the men who have accepted the responsibility for a chairmanship are peculiarly well qualified to conduct this national survey and the committee, as a whole, is an outstanding one and gives great promise of constructive work.

The creation of the committee is a direct outgrowth of the investigation which The American Mining Congress, conducted for the past two years by Mr. G. B. Southward, its mechanization engineer, under the sponsorship of the Mining and Loading Section of its National Standardization Division, Colonel Warren R. Roberts, of Chicago, nationally known authority upon mining standardization is chairman of the Coal Mining Branch of this division. He is cooperating in the development of the new committee, which will in no sense conflict with, or eliminate the activities of, any of the existing standardization committees, but rather, is intended to act as a research committee for the division. The Mechanization Survey has shown that mechanical equipment is being used to such a wide extent and under such varying conditions that at the present time, at least, coal mine mechanization is a subject for research and correlation, rather than standardization. The data and information gathered by the Mechanization Committee will be available to the various standardization committees, and through the cooperation of Colonel Roberts, it is anticipated that from these data, standards will eventually be evolved.

Colonel W. R. Roberts, chairman, Coal Mining Branch, Standardization Division

The purpose of the National Committee on Mechanized Mining is "to promote efficiency, economy and safety in the production of coal." This movement is prompted by the realization that the coal mining industry is now passing through a nation-wide evolution from hand to machine methods and a belief that through the cooperation of those who are engaged in this development, this change will be made with less waste in money, time and effort. That the work will have the earnest cooperation and endorsement of the industry is evidenced by the personnel of the committee, which is as follows:

NATIONAL CHAIRMAN—L. E. Young, vice president, Pittsburgh Coal Co., Pittsburgh, Pa.

VICE CHAIRMAN—J. D. Zook, president and chief commissioner, Illinois Coal Operators Labor Association, Chicago, Ill.

STATE CHAIRMEN

Alabama: D. A. Thomas, president and treasurer, Montevallo Coal Mining Company.

Arkansas and Oklahoma: J. G. Puterbaugh, president, McAlester Fuel Company.

Thomas Dawson, Safety

Cadwallader Evans, Scrapers

Newell G. Alford, Conveyors

Paul Weir, Mechanical Loaders

CHAIRMEN *of* GENERAL COMMITTEES

Two other chairmen whose portraits were not available are George Campbell, Cutting and Shearing, and R. L. Ireland, Transporattion

W. D. Brennan, Management

H. D. Smith, Coal Cleaning

E. E. Jones, Drilling and Blasting

R. Y. Williams, Roof Action

A. C. Callen, Year Book

John M. Carmody, Publicity

Colorado and New Mexico: D. A. Stout, chief engineer of mines, Colorado Fuel and Iron Company.

Illinois: L. D. Smith, vice president, Chicago, Wilmington and Franklin Coal Company.

Indiana: David Ingle, president, Ayrshire Coal Company.

Iowa, Missouri and Kansas: (To be announced later.)

Virginia, Kentucky and Tennessee: (To be announced later.)

Ohio: Ezra Van Horn, general manager, Clarkson Coal Mining Company.

Pennsylvania (Western): W. L. Affelder, assistant to the president, Hillman Coal and Coke Company.

Pennsylvania (Central): E. J. Newbaker, general manager, Berwind White Coal Mining Company.

Pennsylvania (Anthracite): J. B. Warriner, vice president, Lehigh Coal and Navigation Company.

Utah: D. D. Muir, vice president, United States Smelting, Refining and Mining Company.

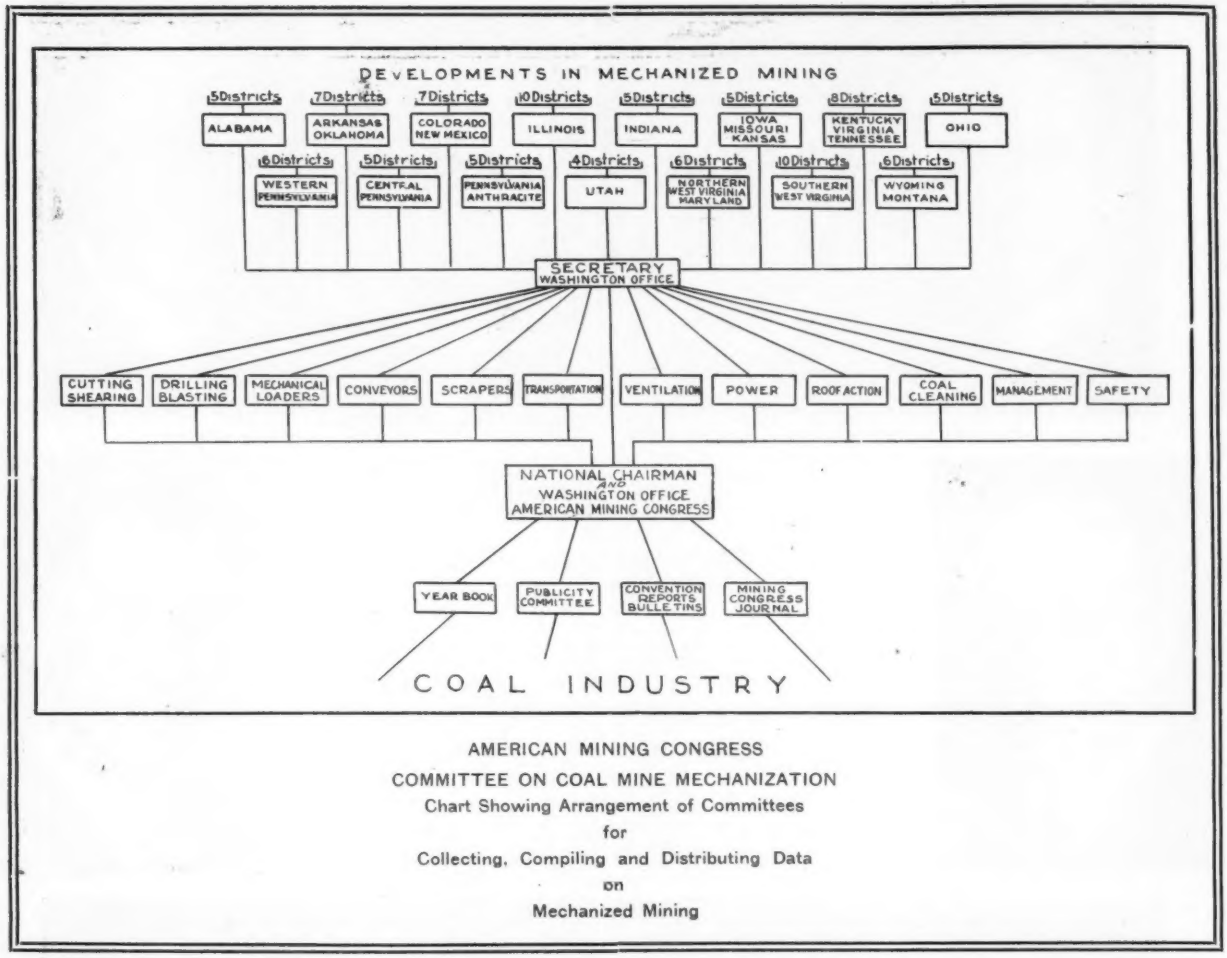
West Virginia (Southern): M. L. Garvey, general manager, New River Company.

West Virginia (Northern) and Maryland: F. R. Lyon, vice president, Consolidation Coal Company.

Wyoming and Montana: Edward Bottomley, general superintendent, Sheridan-Wyoming Coal Company.

GENERAL CHAIRMEN

Cutting and Shearing: George Campbell, assistant to president, Old Ben Coal Corporation.



AMERICAN MINING CONGRESS
COMMITTEE ON COAL MINE MECHANIZATION
Chart Showing Arrangement of Committees
for
Collecting, Compiling and Distributing Data
on
Mechanized Mining

Drilling and Blasting: E. E. Jones, manager, Lillybrook Coal Company.

Mechanical Loader: Paul Weir, vice president, Bell and Zoller Coal and Mining Company.

Conveyors: Newell G. Alford, consulting engineer, Pittsburgh, Pa.

Scrapers: Cadwallader Evans, general manager, Hudson Coal Company.

Transportation: R. L. Ireland, general manager, M. A. Hanna Bituminous Coal Mines.

Ventilation: (To be announced later.)

Power: (To be announced later.)

Roof Action: R. Y. Williams, consulting engineer, Pottsville, Pa.

Coal Cleaning: H. D. Smith, assistant to president, Ashland Coal and Coke Company.

Management: W. D. Brennan, general manager, Phelps Dodge Corporation, Stag Canon Branch.

Safety: Thomas Dawson, vice president, H. C. Frick Coke Company.

Yearbook: A. C. Callen, School of Mines, University of Illinois.

Publicity: John M. Carmody, editor, *Coal Age*.

The committee will be composed of district members, state chairmen, general chairmen, and with a national chairman to coordinate the information furnished by these agencies. For instance, each coal-producing state has been divided into districts, with a district representative to be appointed, who will in fact be an "official observer," to report upon the developments in his district in all matters pertaining to mechanized mining. The district representatives will report to the state chairman, whose duty it is to coordinate and classify this information and to submit the data thus obtained to the general chairmen, who will represent the work nationally according to the various phases of mining. The general chairmen will thus be enabled to make reports upon the developments in the entire industry in Cutting, Shearing, Drilling, Blasting, Mechanical Loaders, Conveyers, Scrapers, Transportation Systems, Ventilation, Power, Roof Action, Coal Cleaning, Management Problems, and Safety Work.

In announcing the formation of the committee, The American Mining Congress makes the following statement of its purpose and scope and the results it hopes to obtain:

"The purpose of The American Mining Congress in organizing the National Committee on Mechanized Mining is to provide a means for keeping the industry informed concerning the developments in mechanization and to furnish coal operators with current information—to show what is now going on rather than what took place a year or two ago. The Mechanization Survey which has been conducted during the past year and a half has indicated that the successful operation of loading equipment is reaching such proportions that it is of vital interest to every coal operator — whether his mine is now mechanized or not—to keep in close touch with this movement.

"The work of this committee will be nation-wide in its scope and the organization, with its state chairmen and district members, will cover every coal producing field in the United States. Experience has now shown that the change from hand to mechanical loading affects to a greater or (*Continued on page* 843)

©Harold Gray

Along the lower Potomac

"In the after silence on the shore"

CONSOLIDATED RETURNS REGULATIONS *under* 1928 REVENUE LAW

Importance Of A Better Defined Procedure To Govern Assessment And Payment Of Tax In The Case Of Affiliated Corporations Urged At Treasury Hearings—Double Taxation Shown

AT THE hearings before officials of the Treasury Department on the income tax regulations, with particular reference to consolidated returns of corporations, Mr. H. B. Fernald, of New York, a member of the General Tax Committee of the American Mining Congress, urged the department to promulgate in the new regulations a better defined procedure to govern assessment and collection of the income tax in the case of affiliated corporations. Mr. Fernald made certain recommendations as to the manner of evidencing any agreement existing between the corporations that the tax should be all assessed against and paid by the parent corporation or that it should be apportioned on some agreed basis among the several affiliated corporations. He said that probably much of the confusion and uncertainty now existing in the department as to past settlements could be eliminated by simply asking the corporations if they have agreed that the tax should be assessed upon the parent company. Mr. Fernald submitted a memorandum to the department on the subject that should be of interest to every corporate enterprise. As to the basis for computing gain or loss in the case of affiliated corporations, he said:

"Were the department free to accept the same basis as do accountants for a single corporation or for a consolidated statement, this would be simple of solution. The accountant, in the statement for an individual corporation or for a consolidation, simply directs his attention to the present unit, virtually ignoring anything which may have gone before. If the property when acquired by the present unit had a value of $1,000,000 we are not concerned with any question of whether its cost to prior owners was more or less than this amount. We, in the corporation's accounting, are not concerned with what might have been the gain or loss to a prior owner. We may well know that property had cost the prior owner $100,000, but our statement of its present ownership has nothing to do with the situation of a prior owner.

"This is true even as to cases where the present income tax law requires that for income taxation the present corporation (having acquired the property in a reorganization) will have the same basis as had the prior owner. State corporation and dividend laws may make it practically obligatory that the property should be taken up in the accounts of the acquiring corporation at its value when acquired, and directors might become even criminally, as well as financially, liable if they declare dividends from a standpoint of A's having the same capital basis for the property as B. If A issues $1,000,000 of bonds to acquire property from B, it is practically obligatory that A should take up that property on its books at $1,000,000 even though for income tax purposes it is required to account for any profit on a sale at B's basis of $100,000. There is nothing in the state corporation or dividend laws so far as I know them that in any way compares with the reorganization provisions of the present act.

"As with the individual corporation, so with the consolidated statement. The accountant simply considers the consolidated unit as he is now dealing with it. If property when it came into the consolidation, either directly or through stock ownership, has a certain value, this the accountant considers as the consolidation's basis regardless of any basis it may have had under prior ownership. This is true even though the property still stands in the name of the same corporation as formerly. If A acquires all the stock of B, we do not look to see what was the original cost of the property to B but what was the cost of the property to A. If A paid $1,000,000 to acquire the property, we use this figure even though the original cost of such property to B was $100,000 and even though B continues to carry this property on its books at $100,000.

"We may therefore say that the accountant simply recognizes the 'stepped up' basis and is not concerned about it.

The Treasury Department has been much concerned that the 1921 law did, to some extent, allow such a "stepped up" basis without definitely taxing to someone the difference between the old and the new values. Personally, I think the department was too much concerned about this, due to its failure to recognize the many cases where in equity there ought to be a "stepped up" base, although the law does not allow it. Let me illustrate:

X pays for stock of Corporation A	$100,000
A buys certain property for	100,000
Then the basis of the stock to X and the basis of the property to A is	100,000
Now suppose—	
Case I:	
If A sells its property to Y for	$500,000
A liquidates and distributes to X	500,000*
Then A is taxable on	400,000
X is taxable on	400,000*
Y has a future basis for the property	500,000
Here the same profit has been twice taxed.*	
Case II:	
X sells his stock in A to Y for	$500,000
A later sells its property to Z for	500,000
A liquidates and distributes to Y	500,000*
Then X is taxable on	400,000
A is taxable on	400,000
Y apparently has a loss by the amount of tax paid by A.	
Z has a future basis for the property	500,000
Here, again, the same profit has been twice taxed (with a loss to Y which he may or may not be able to deduct).	
Case III:	
A liquidates and distributes the property to X when the property has a value of	$500,000
X sells the property to Y for	500,000
Then A has no tax to pay on liquidation	
X is taxable for gain on liquidation	400,000
Y has a future basis for the property	500,000
Here only one tax is paid on what is, as to the effect, the same transaction as is twice taxed in Case I.	

* Less the amount A pays as tax and so does not have for distribution when it liquidates.

Double Taxation

"Here we have in Case I and Case II double taxation of the same profits, whereas in Case III there is only one tax to be paid. Case III is clearly the same as Case I except that in Case I there was a failure to take advantage of a technical step which would have prevented such double taxation.

"Case II is brought in to illustrate how the same result of double taxation follows from a failure to allow the 'stepped up' base to A. It seems unnecessary to introduce the further case (to more closely parallel Case II) where Corporation A would first liquidate to X; then X would turn the property over to a new Corporation B, the stock of which X would then sell to Y, so that it would be Corporation B which sold the property then liquidated to Y. Here the only tax to be paid would be by X on the liquidation of A. There would be no tax to B, which would have the 'stepped up' base for the property, when it is sold, nor would there be a tax to Y when distribution was made to him. There is no reason in equity why such technicalities should make these great tax differences as to transactions which bring about the same final results.

"If Y's payment of $500,000 to A to acquire all his interest in the property entitles Y to a 'stepped up' base in the one case, it should equitably entitle him to a 'stepped up' base in the other.

"I know how thoroughly the ground was covered in formulating the several revenue acts in an endeavor to get a fair balance between technicalities and equity. It is very unfortunate that in some cases a failure to observe the technicalities brings results most regrettable to the taxpayer, but we have not seen as yet a way to avoid this. However, if we abandon the graduated surtax on individuals, if we cease to recognize corporate entities and only consider the ultimate ownership of stockholders (as we do that of the members of a partnership), and merely impose a single flat tax rate on all incomes, we could then proceed to write a law aimed only to tax true income, and to tax it only once, with some fair hope of reasonable success. This, however, is not the basis of our law. We have made the determination of income a matter of technicalities as the only way in which we can handle our present system of income taxation.

Annual Option

"A further complication is introduced into the law by the annual option which is now given in any year to file separate or consolidated returns, regardless of what might previously have been done. It is, of course, conceivable that we might have in one year in the consolidated return one basis for computing gain or loss, depreciation and depletion, and then in the next year, with separate returns, a different basis, but it seems to me this would make great confusion and from an administrative standpoint it would seem to me very desirable to have the basis for the property continue unchanged during a continuation of present ownership. Unquestionably, my thought has been greatly influenced by this consideration.

"In harmony with the present technical basis of our income tax law, the best and most consistent basis I have been able to formulate in my own mind is substantially as follows:

"(a) There should be no change in basis of value during a continuation of the same ownership of the property.

"This would mean that if a parent Corporation A acquires the stock of Corporation B, the basis to the subsidiary B for computing gain or loss on its property and the basis which would be used in a consolidated return would be the same that B had had prior to the consolidation. B would then have the same basis for this property whether a consolidated return or separate returns were submitted.

"(b) If a subsidiary is liquidated, no gain or loss would be computed on the transaction, but the basis for the property thereafter in the hands of the parent corporation would be based on the cost to the parent company of the stock which it had acquired in the subsidiary.

"This in equity is the basis which the parent corporation should have. It should carry the property at what such property actually cost it. We do not have to deal here with any compilation of separate returns in another year because so long as the property is owned by the parent corporation it must continue this same basis.

"This would, of course, mean that if such property was after consolidation sold by the subsidiary, profit or loss would be computed on the basis of the cost of such property to the subsidiary, whereas if the property were first conveyed to the parent corporation by liquidation of the subsidiary, profit would be figured on the basis of its real cost to the parent.

"If we have the case of property sold by a subsidiary to the parent under a consolidated return, there should be no tax on such intercompany profits. I am inclined to think, however, that such property should then stand for income tax purposes to the parent company on the basis of the cost of such property to the parent company as measured by the cost to it of its stock (or a pro rata part thereof if it is determinable that the amount paid by the parent company for the stock was based on a valuation for the property which differed from the figure at which it was theretofore carried by the subsidiary).

Intercompany Transactions

"The present Regulations 69, in Article 635, include the wording 'subject further to the elimination of intercompany transactions (whether or not resulting in any profit or loss to the separate corporations)'. Manifestly, the only way in which 'intercompany transactions' enter into income so that they can be eliminated therefrom is when there is a resulting profit or loss. Transactions which do not result in any profit or loss to the separate corporations would not be included in their respective net incomes, and manifestly that which is not included in net income can not be eliminated therefrom.

"As was brought out by one of the speakers at the Consolidated Returns hearings, neither the Department nor the taxpayers have made any serious attempts in the ordinary case to compute consolidated net income by an ac-

Moonlight on the White House

©Ernest L. Crandall

counting which would definitely eliminate all intercompany transactions whether or not these resulted in any profit or loss to the separate corporations. We may, of course, say that when we have an income credit to one company balanced by an income deduction of another company, we have effectively eliminated the intercompany transaction from the consolidated net income. We have not, however, eliminated the transaction because the transaction will still be recognized as having taken place as between the respective companies and all we will do will be to eliminate such, if any, amount as is merely an intercompany profit. If, however, there has been a real profit to the consolidation by sale to an outsider, we will fully recognize that that profit accrued to the several consolidated corporations on such basis as may correspond to their intercompany transactions. For example, if A transfers to B, at $1,100, property which cost it $1,000, and B still holds the property at the end of the year, we eliminate this $100 of intercompany profits from the consolidated income of the year, but we must necessarily recognize that there has been a transfer of this property from A to B. If, however, after such a transfer B sells this property to an outsider for $1,250, we recognize the $250 profit and moreover recognize that it has accrued $100 to A and $150 to B. It will so show in a consolidated surplus statement, as well as in a consolidated balance sheet.

Net Losses

"Section 117 of the 1928 Act treats a 'net loss' as 'a deduction in computing the net income of the taxpayer for the succeeding taxable year,' etc. If we unreservedly apply the doctrine that each corporation is a separate taxpayer and that consolidated net income of any year 'shall be the combined net income of the several corporations consolidated,' we should then find—

If, for 1928	
A had net income of.....	$100,000
B had net loss of.....	50,000
and for 1929	
A had net income of.....	100,000
B had net income (before deducting any 1928 net loss).	60,000

we should under Article 635 of Regulations 69 apply 'the provisions covering the determination of taxable net income of separate corporations' and determine the taxable net income of B for 1929 as being only $10,000, and then (there being no intercompany transactions) our combined net income of corporations A and B for 1929 would be only $110,000. This would, of course, wholly disregard the fact that B's net loss for 1928 had already been in a consolidated return for that year applied to offset $50,000 of A's net income for that year. * * *

"If we accept as fundamental theory of the law that 'net losses' constitute deductions in computing the net income of each separate corporation, except to the extent that such net losses have theretofore been applied to offset net income which would otherwise be taxable in a consolidated return, then I think we will find it a relatively simple proposition to formulate the correct rules.

"Such a theory would mean—

"(1) That a corporation newly entering a consolidation would have the right to deduct in computing its net income any 'net loss' which it might have the right to carry forward from the prior year during which it was making a separate return.

"(2) Any corporation leaving a consolidation would have the right to deduct in computing its net income of the subsequent year any 'net loss' which it might have sustained during the period of affiliation which was not applied in reduction of net income which otherwise would have been taxable to the consolidation.

"There doubtless will be some difficult questions in any event arising in cases where the particular corporation under consideration as newly entering or leaving the consolidation, is only one of several corporations which have net losses. Under such conditions the taxpayer in filing his return should have the right to state which losses it considers are offset against other income of the consolidation and which are net losses to be carried forward and if it does this, this should be a determination to be followed for the future, except where a redetermination by the Commissioner makes the taxpayer's allocation inapplicable. In any such case the Commissioner shall, in stating his determination of net income, set forth his application of the loss, giving the taxpayer the right by timely protest to state his own basis of allocation. If the taxpayer does by timely protest make such allocation, then it should control; otherwise, the Commissioner's determination will stand.

"Needless to say, I believe that in computing the net loss of any corporation during the period in which it is included in a consolidated return, any intercompany dividends, etc., should not be taken into account.

Stock Transactions

"As indicated by the preceding discussion, I would consider the sale by one corporation of the stock which it owns in an affiliated corporation as a sale of property by it wherein gain or loss was to be computed to it in the same manner as if it were selling any other property. If the vendor corporation had purchased such stock for cash or its equivalent and sells it for cash or its equivalent, gain or loss would be computed on the basis of the difference between cost and selling price.

"If the vendor corporation acquired such property at March 1, 1913, or in any other manner so that its basis was other than cost, and disposes of such property in a transaction such that gain or loss is to be recognized, the gain or loss would be computed accordingly. If the vendor corporation disposes of the property in such a manner that under the reorganization provisions no gain or loss would be recognized regardless of affiliation, then there would be no recognition of gain or loss from the transaction and the vendor corporation would have such basis for the stock or other property which it received in exchange for the stock it sold as is prescribed under the reorganization provisions.

"Of course, no gain or loss would be recognized in any purely intercompany transaction where one affiliated corporation sells stock which it owns to a corporation with which it is affiliated."

PERCENTAGE DEPLETION FOR MINES

The Joint Committee on Internal Revenue Taxation will have before it for consideration at the opening of Congress in December a report of its investigating division on the proposed percentage depletion for mines.

While he will not pass on the question until all the facts are developed, Representative Hawley (Rep., Oreg.), chairman of the joint committee, in a letter to Senator Reed (Rep., Pa.), a member of the committee, says a percentage basis applied to net income would seem logical. Senator Reed had been asked by the American Mining Congress as to the status of the depletion investigation which has been under way for some time. Representative Hawley states that the investigating division completed a preliminary report last spring on percentage depletion based on gross income. This report was not issued because L. H. Parker, chief of the division, believed the subject had not been fully covered and that the gross income basis as applied to the mining industry other than oil and gas was not sound. Since then the study has been devoted particularly to the net income basis. Mr. Hawley says this method "gives promise of resulting not only in greater simplification but also in greater equity as between taxpayers." Continuing he says:

"It is well known that the most commonly employed method of valuation of mining properties is the analytical appraisal method. This method bases the value of the property upon its future expected profits. In view of the fact that the net income from the property is representative of such profits (only actual instead of expected), it would appear that a percentage method based on such a figure has, at least, some foundation in logic."

METAL MINING BRANCH of STANDARDIZATION DIVISION *has* NEW CHAIRMAN

LUCIEN EATON Accepts Appointment As National Chairman—Work To Be Reorganized—Metal Mine Handbook To Be Issued

LUCIEN EATON, superintendent, Ishpeming District, the Cleveland Cliffs Iron Company, has accepted the invitation of the Board of Directors of The American Mining Congress to act as the national chairman of the Metal Mining Branch, Standardization Division, of that organization. Mr. Eaton brings to the work a wide experience in metal mining, and the organization is fortunate in having secured his leadership for this phase of its work.

Mr. Eaton is a graduate of the School of Mines of Harvard University, and has been employed by the Cleveland-Cliffs Iron Company, as engineer and mine superintendent for the past 25 years, being at present district superintendent at Ishpeming, Mich. In addition to his work in the iron industry he has visited most of the important mining districts in the United States, and has done consultation work in South America, Canada, and Russia, and was with the Engineer Corps of the United States Army in 1918.

He has taken an active interest in the standardization work of the Mining Congress since its inception, being chairman of the National Committee of the Metals Branch on Mechanical Loading Underground. The recommendations of his committee are now a national standard, having received the approval of the American Engineering Standards Committee as recommended American practice.

Mr. Eaton plans the complete reorganization of the Metal Mining Branch, incorporating the recommendations of the division that have reached that stage, in a Handbook of Standard Methods, Practice and Equipment. New committees will probably be organized and the present personnel of the division augmented.

The Metal Mining Branch of the American Mining Congress was organized about six years ago, and during that period, under the leadership of Charles A. Mitke, of Phoenix, Ariz., has obtained American Engineering Standards Committee approval on two standards, Mechanical Loading Underground and Underground Transportation. Another project of the division now before the American Engineering Standards Committee is that of "Fire Fighting."

Among the projects the Metal Branch is sponsoring, and which will continue to function under Mr. Eaton's direction are:

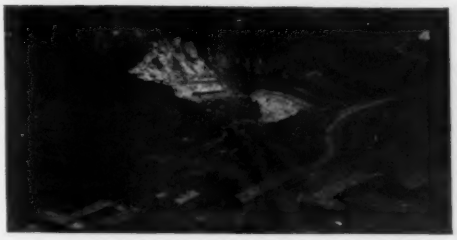
Underground Power Transmission and Power Equipment; Drainage; Ventilation; Milling and Smelting Practices and Equipment; Methods of Mine Sampling, Methods of Recording Underground Geological Data, and Methods of Estimation of Ore Reserves for Low, Medium and High Grade Ore Bodies; Mining Excavating Equipment, Exclusive of Dredges; Mine Accounting; Drilling Machines and Drill Steel; and Mine Timbering.

Announcement will be made shortly concerning the proposed handbook, as well as the personnel of the division. The work promises much for the metal industry, and Mr. Eaton's qualifications insure its success.

METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry



The NEW CENTRAL POWER PLANT *of the* COMMERCE MINING & ROYALTY COMPANY

By GEO. J. STEIN *

Absolute Freedom From Oil And Water In Basement—Nine Months' Oil Storage Provided—Especially Designed Cooling Equipment—Color System For Piping Used—Low Voltage And Interruptions Eliminated—Force Feed And Continuous Gravity Lubrication Employed.

A LARGE portion of the lead and zinc produced in this country comes from the Tri-State Field. At one time most of these metals came from Missouri and Kansas, but in recent years operations have shifted across the line into Oklahoma, due to the finding of a much richer ore.

One of the largest producers is the Commerce Mining & Royalty Company at Miami, Okla. Each year it has ranked among the leaders in its production. The amount of ore produced, however, could be materially increased were it not for the restriction of its operations. The growth of this company has been phenomenal. The foundation goes back to 1905, when J. F. Robinson, G. L. Coleman, A. E. Coleman, and C. M. Harvey organized as a royalty company engaged in drilling and exploratory work. They were the first to discover ore in the Oklahoma field. These four principals are still actively engaged in the company's affairs. In 1907, the Miami Royalty Company was formed and mining started on a small scale. During the years which followed, operations were increased and large acreage acquired, which to a great extent formed a basis for the strong position the company now enjoys. In 1913, the name was changed to the Commerce Mining & Royalty Company. From its small beginning the company has grown to one which has larger ore reserves than any other company operating in this field. It is estimated that its present known reserves would permit a weekly production of 1,000 tons of concentrates for the next 35 years.

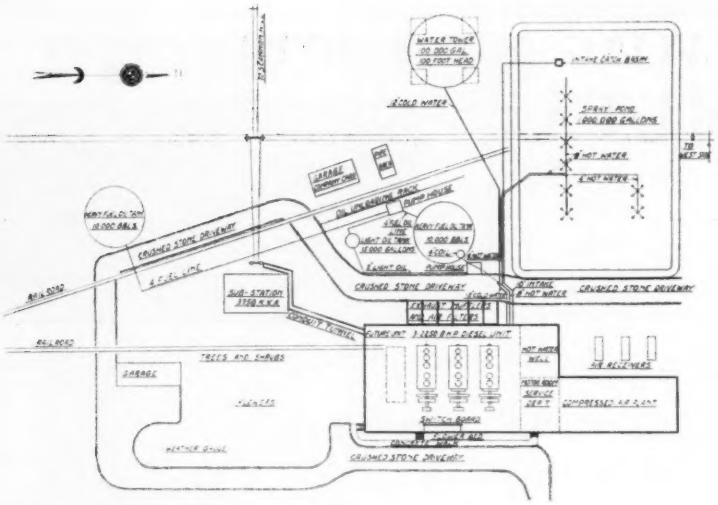
*Chief Engineer, Commerce Mining & Royalty Co., Miami, Okla.

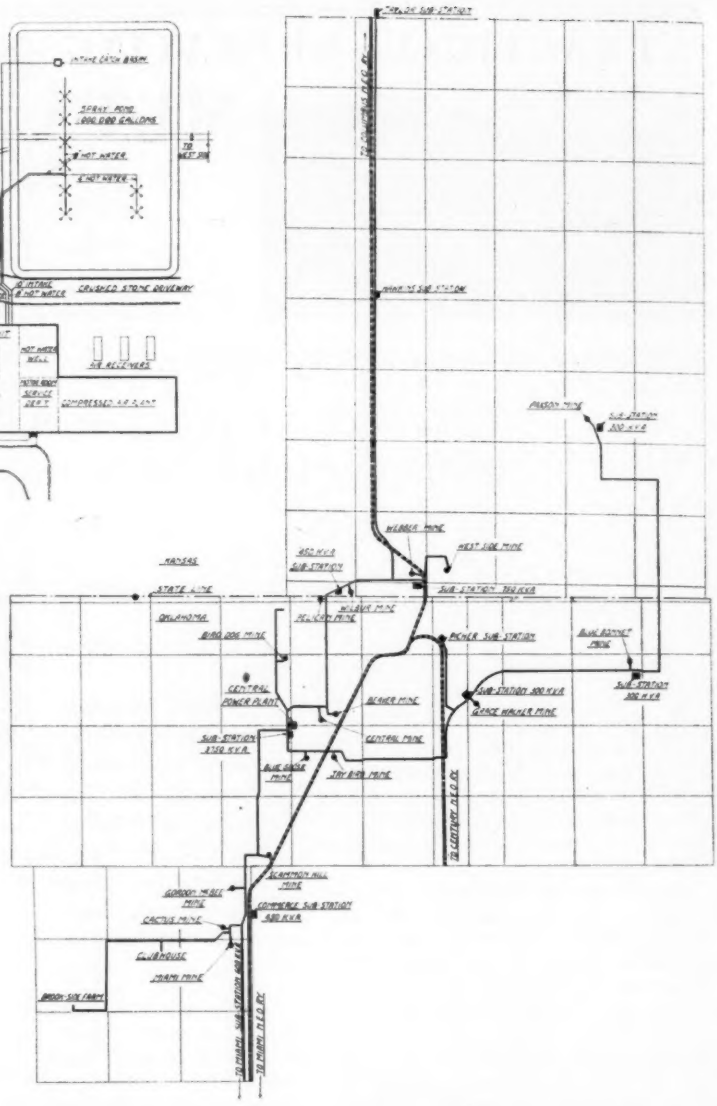
DIESEL ENGINE CHOSEN

The building of a central plant for supplying compressed air for the various mines and later the central Diesel power plant are examples of the foresight and aggressive policies of this company. A compressor station built in 1925 supplies air through 12 miles of pipe line. This was a new venture in the field and naturally resulted in considerable comment, some questioning the advisability of such a project. The performance of this plant, from the viewpoint of service and cost of air, has been very satisfactory. In fact, the success of this plant to some extent was an influencing factor which later led to the installation of a central power plant.

In 1926, a survey was made to determine the advisability of installing

The Diesel engine plant of the Commerce Mining & Royalty Company at Cardin, Okla.



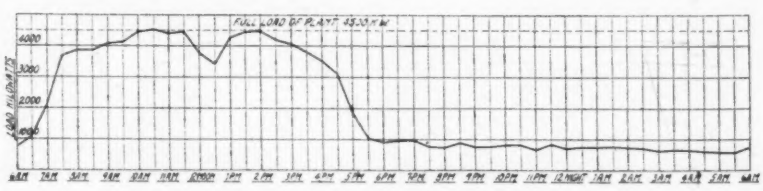


Above—Layout of power plant, showing arrangement of main and accessory equipment. Right—Electric transmission line

equipment to supply the power needs of the company. It was believed that with the great amount of power used, and with the assurance that the ore reserves would permit of at least 35 years mining operations, that power could be produced at a substantial saving over the then present arrangements. A number of isolated plants were maintained aggregating about 500 horsepower in gas engines, balance of the power being purchased. It was contended that if the three large compressors centrally located could produce air at lower cost and give better results, power could be supplied in a similar manner. As a result of this survey, also an investigation of the type of power unit most suitable for the conditions, three 2,250-horsepower Nordberg Diesel engines were selected, each driving a 1,500-k.w., 2,300-volt, 3-phase, 25-cycle generators with 40-k.w. direct connected exciter. The engines run at 125 r. p. m. The decision to turn to Diesel power was influenced to some extent by the performance of three other Diesel plants of 9,400, 6,900, and 6,250 horsepower, which had been operating satisfactorily for more than five years, all being in mining service. These plants had Nordberg engines, and among them were four engines of the same size installed by the Commerce Mining & Royalty Company. This new Diesel plant, with its 6,750 horsepower, is the fifth largest in North and South America, and, viewed from an engineering standpoint, it is a model in power-plant design.

It is located just west of Cardin at a point about central with respect to the various properties and the present known ore reserves. This location was in reality determined in 1925, when the compressor plant was built on this site. The engines supply power for 18 mines and mills, the central air plant, the Northeast Oklahoma Railway, a subsidiary road with 53 miles of track, and stand-by service to the city of Miami. Construction on this plant was started in August, 1926, and placed in regular service in August of the following year.

All the details incident to design, layout and construction of the plant were handled by the engineering department of the company under the direction of the chief engineer in conjunction with the engineers of the Nordberg Mfg. Co. This, of course, was no small task. It was especially difficult when it is remembered that with Diesel plants of this size there is very little data available; furthermore, there is little opportunity of benefit from the past experience of others, as is the case with steam installations. Every detail, however, has been carefully worked out and as a result the plant is a model of convenience from the



Load curve showing the load on the Diesel plant for an average day

operator's point of view. The success of both the air and power plants is proof of the soundness of these projects.

Transmission Lines and Substations

In addition to building the power plant, about 35 miles of primary and secondary transmission lines had to be built, also substations constructed at the mines and along the railway. The primary lines carry 33,000 volts and the secondary 2,300. The step-up transformers and outdoor switch station are located in the power-house yard and are of sufficient capacity to take care of future expansion, in case another power unit is installed. Transmission lines also are liberally proportioned, eliminating objectionable voltage drop and permitting of a material increase in load should mining operations be later increased.

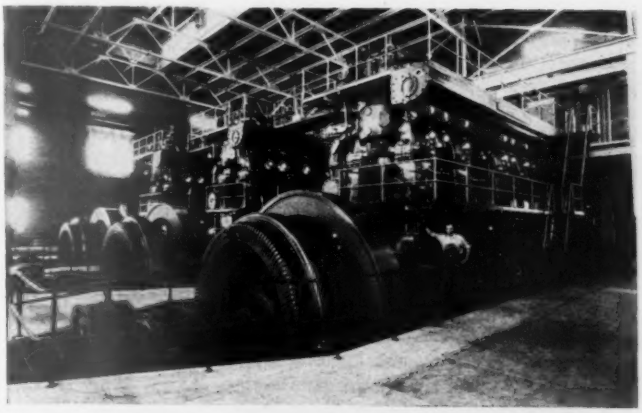
The widespread holdings of this company are best shown by the fact that practically all the transmission lines are on owned or controlled property. The annual rentals for ground used for the transmission lines do not exceed $300. The longest line going to any mining property is about 10½ miles, while about 15 miles of line are required to reach the farthest railway substation.

Building and Grounds

The building housing the engines is 80 x 120 ft. inside with a 45-ft. headroom underneath the roof trusses. The original installation consisted of three units, but there is ample space left for a future unit. The building is of steel frame construction with lock bond tile walls 13 in. thick, and a 3-in. concrete roof with Hi-Rib reinforcing overlaid with a 5-ply Johns-Manville roof. The floor is smooth finished concrete enameled gray. All openings around the engines are covered with steel gratings.

In the basement are located the water circulating pumps, centrifuge, fuel-oil filters, spare parts storage, lockers and change room for employes. The basement is unusually clean, the floor and foundations about the engines being absolutely free from water and oil, and present quite a contrast to the ordinary Diesel plant where no provision has been made to confine such drips. The entire interior is in keeping with modern power-plant practice. It shows what can be accomplished by the machinery builder and plant designer when special precautions are taken to eliminate minor leakages, which so often mar the appearance of Diesel plants. The basement headroom is 10 ft.

The switchboard is located on the engine room floor. The office for the plant engineer is on an elevated platform in the southeast corner. The engine room proper is served by a 20-ton, 60-ft. span Harnischfeger traveling crane with cab control.



Three 2250-hp. Diesel engines, each driving a 1500-k. w. generator

Showing overhead platform arrangement around engines and gallery where the various oil supply tanks are located

Adjacent to the engine room at the north is the motor service room, under the floor of which is the hot well. Beyond the motor service room is the central compressor plant, in which are installed three 2,200-cu. ft. two-stage Worthington compressors, driven by 364-hp. Westinghouse synchronous motors. The water for compressor cooling is secured from the spray pond. In the preliminary building plans, an investigation was made in regard to the utilization of waste heat for building heating during extreme cold weather. It was found, however, that the cost of such a system was exorbitant for the short time it would be required. Since natural gas is available at a reasonable price, it was decided to use Clow Gasteam radiators, there being five in the main engine room. During the first winter, with but one engine running on the coldest nights, and with an outside temperature near zero, the temperature inside never went below 60 degrees. The cost of heating both the engine room and electrical department did not exceed $30 during any month.

The power plant site covers a tract 400 by 700 ft., enclosed in a high wire mesh fence. Although the landscaping has not yet been completed, when finished the flower beds, trees, and shrubbery, together with the crushed-stone driveways with boulder walls, will add greatly to the exterior appearance.

Mufflers and Air Filters

The exhaust mufflers, together with the air filter chambers, are built of reinforced concrete and located outside the west wall. Each is 10 ft. wide, 14 ft. 6 in. long, and 18 ft. deep, with a baffle wall down the center, all the walls being 9 in. thick. The exhaust and suction pipes are 28 in. in diameter, made of welded steel, the former approximately 50 ft. high, extending to the power house roof, while the latter is 28 ft. high, surmounted by a hooded screen. With this arrangement the noises of the exhaust and suction are effectively silenced.

Each air filter chamber is equipped

with 27 standard Reed filter sections measuring 20 in. square. After 10 months of operation, six sections were removed from each chamber for cleaning. These had accumulated the major portion of the dirt. It is the plan to clean but a few sections at similar intervals.

Fuel Oil

Adequate and convenient fuel-oil storage is provided. Heavy fuel oil is stored in two 10,000-barrel steel tanks and light oil in a 15,000-gallon tank, all located above ground. This provides for about nine months' operation with the average load so far carried. With this amount of storage it is possible to purchase fuel in quantity under favorable market conditions. To guard against the possibility of a disastrous tank fire, caused by lightning or other sources, a Foamite System is being installed.

Oil is brought in the plant yard over a switch leading off the company's railroad. A 4-in. unloading rack permits three cars being unloaded at a time, which can be accomplished in about four hours. In the unloading pump house, a building of fireproof construction, is a size 6P Blackmer pump gear driven by a 7½-hp. Westinghouse motor. The piping is so arranged that one pump handles either heavy or light oil, and also can be used for transferring heavy fuel from one tank to the other. Since the plant was placed in service, the north tank has been used as a regular source of supply, the south tank for storage only. Each tank has a heating coil of 4-in. pipe of about 250 sq. ft. of heating surface connected to the hot-water discharge line from the hot well to the spray pond. This hot-water pipe and fuel-oil line are enclosed in the same insulation in order to eliminate as much as possible a temperature drop from the fuel tank to the engine room. A small vertical boiler is also placed in the yard to provide heating for tank cars in extremely cold weather.

The transfer pump house is of similar size and construction as the unloading house. Here are two pumps, one is a No. 2 Viking driven by a 5-hp. Westinghouse motor and used for heavy oil; also a No. B Viking driven by a 2-hp. Westinghouse motor for light oil. These pumps are arranged with push-button control and are operated from the upper gallery in the engine room.

Fuel-oil storage for all three engines is carried in two daily fuel supply tanks located on the west wall just below the roof. The piping is so arranged that either tank will supply any two engines. Each tank has two compartments, one for heavy and the other for light fuel. Just below the fuel tanks are the fuel-oil filters to which the oil flows by gravity, and from the filters passes on to the fuel pumps. The supply tanks and filters are provided with heating coils, hot water for this purpose being taken from the jackets of the exhaust-pipe elbows. In order to secure a higher water temperature than is obtainable from the exhaust, this is supplied from a coil of 3-in. pipe placed in the exhaust pipe. Normally the temperature of the water is regulated to keep the fuel-oil temperature at about 120 degrees Fahrenheit. Daily supply tanks and filters are of Nordberg design. The engines operate on heavy fuel oil of approximately 14-16 degrees Baume, while the light fuel oil is 32-36.

Lubricating Oil

With the exception of the power and compressor cylinders, lubrication to all parts of the engine is supplied from a gravity system. After passing through the engine, the oil drains into a Nordberg gravity type filter placed in the basement. A gear-type pump, chain driven from the engine shaft, transfers the filtered oil to the three overhead lubricating oil storage tanks located on the same level as the fuel-oil filters and is again ready for circulation. These storage tanks are equipped with cooling coils, permitting a uniform oil temperature to be maintained. All the cooling water going to each engine is brought to these coils through a 6-in. line, but a bypass at the engine room floor allows all or a portion of water to be bypassed, depending upon the amount of oil cooling required. During the winter it is not necessary to cool the oil.

In addition to purifying the oil by gravity filteration, a No. 6 Sharples Super Centrifuge is also used. The original charge of oil is still being used after nine months of service, the oil being clear and giving satisfactory lubrication.

The centrifuge is located in the basement and is kept in consequent service, it being customary to use it on the engine that is on the 24-hour run. The drain piping of each engine is so arranged that the oil going to any filter can be sent through the centrifuge instead, and for that day the oil is purified by this manner. A small belt-driven gear-type pump transfers the cleaned oil from the centrifuge discharge tank to the proper overhead oil storage tank.

Cooling Water

One of the most important requirements for successful operation of any Diesel engine plant is an adequate supply of suitable cooling water, together with a properly designed cooling system. Many Diesel plant troubles are directly traceable to this source. It is a well-known fact that cylinder liner, cylinder head, and piston troubles resulting in high maintenance costs and interrupted service, are frequently caused by improper water conditions, or the manner in which the system is arranged. Water forming heavy scale deposits is ever a source of worry to the plant operator, and is something that is often considered too lightly. The water question is a vital one in any plant, whether large or small, and is worthy of the most careful consideration. This detail has been carefully worked out in the Cardin plant. The source of supply is obtained from a near-by company mine and, fortunately, carries very little scale-forming material. Instead of depositing scale, as is the case in most Diesel plants, the water seems to have a slight corrosive action, which is being corrected by treating the water in the spray pond.

The water after passing through the engines drains into a 12-in. header, which empties into the hot well 30-ft. wide, 40 ft. long and 8 ft. deep. The pumping equipment for the water cooling system is located in the north end of the basement. Two pumps are provided for discharging from the hot well to the spray pump, but only one is normally required, the other serving as an emergency. American-Marsh centrifugal pumps are used having a capacity of 600 gallons per minute at 75-ft. head and direct connected to 20-hp. Westinghouse motors running at 1,450 r. p. m. These pumps have a 6-in. suction and 4-in. discharge and connect into the 8-in. spray pond discharge line. This line terminates in 24 spray nozzles.

From this line a 4-in. connection is made permitting a portion of this hot water to circulate through the heating coils in the large fuel-oil storage tanks. This 4-in. line is provided with a valve to regulate the amount of flow in accordance with the oil temperature, and terminates in eight spray nozzles. The spray nozzles were furnished by the Cooling Tower Company. The normal pressure carried on the hot-water line is about 15 pounds. From the spray pond, a 10-in. intake line leads to the basement, where there are three American-Marsh centrifugal cold water pumps. These are also of 600 gallons per minute capacity at 175-ft. head. They are driven by 50-hp. Westinghouse motors running at 1,450 r. p. m. One pump is ordinarily used except on hot days, when two are required. The arrangement of the piping also permits any one of these larger pumps being used for discharging from the hot well to the spray pond, taking the place of the smaller hot-water pumps should they fail. These three pumps discharge into a 12-in. cold-water line at a pressure of between 70 and 75 pounds. This 12-in. line, from which the engine cooling water connections are taken, is

also connected to the 100,000-gallon overhead steel tank, located about 100 ft. above the ground level. By draining roof water into the spray pond, soft water is obtained for a portion of the makeup.

Color System of Piping

The following color system for piping is used:

Cold water—light green.
Hot water—yellow.
Fuel oil—black.
Lubricating oil—light blue.
Electrical conduits—red.

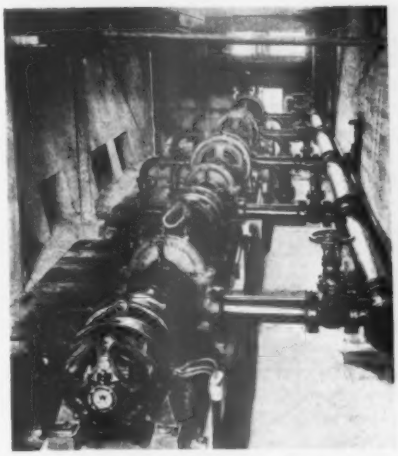
Auxiliary Compressor

It is a remote possibility that a plant of this size and with the number of units installed, the air supply in the starting bottles will be entirely exhausted, and starting of the engines thereby prevented. However, to guard against such an occurrence, an auxiliary compressor has been installed in the basement. This is a two-stage 4½-in. x 2-in. x 4½-in. Gardner-Rix driven by a 10-hp. Novo gasoline engine.

Load

When the engines were placed in service in August, 1927, the connected motor load was about 4,400 hp., exclusive of the railroad. In 10 months this motor load has grown to 6,400 hp., and to which must be added a 500-k.w. frequency changer set supplying the city of Miami. The load is roughly divided about 80 percent for mining and 20 percent for railroad. The latter load not only includes electric interurban and freight service from Miami, Oklahoma to Columbus, Kans., but also switching service to many of the mines in this field, which is done by two 50-ton electric locomotives. This work is largely done during the night when the mining load is off.

Referring to the diagram showing load curve, it will be noted that for eight hours during the day period the plant is carrying practically full load. In fact, there were times late in 1927 when it was necessary to transfer part of the mill load from the day to night shift. For the balance of the time the load drops as low as 400 k.w. This results in an unfavorable load factor, slightly more than 30 percent. In addition, the power factor is low, this being 80 percent from 8 a. m. to 4 p. m., 61 percent from 4 p. m. to 12 p. m., and 53 percent from 12 p. m. to 8 a. m. Operating under such unfavorable load conditions, any type of power unit, other than the Diesel engine, would find it difficult to show good power costs. While lower power costs could be secured under better load conditions, they are very close to those in the estimates of the original power survey. Even with the plant operating in this manner, it will pay for itself in six years, based on the savings over purchased current at the rate of 1.75 cents per k.w. hour. The operating force consists of a plant engineer, three shift engineers working eight hours each, and an oiler on each shift. During the eight-hour heavy load period three engines are kept in service, but from 5 p. m. to 6 a. m. only one is required. The 24-hour run is shifted among the three units.



Circulating water pumps located in basement

Quality of Service

Since the Diesel plant has been in operation, the quality of service received at the various properties is considerably better than formerly. Low voltage, a one time common cause for complaint, has been eliminated, and interruptions to service are a rarity. At no time has the plant ever been shut down completely, the most serious occurrence being an engine down for a few moments necessitating taking current off of some of the lines for a short period. During the first five months the plant was in service the total interruptions on all transmission lines were as follows:

Engine trouble—1 hr. 20 mins.
Operating mistakes—16 mins.
Miscellaneous (storms, electrical repairs, etc.)—44 mins.

So far for 1928, the record is equally good. When considering the fact that an operating force had to be developed and trained, and also that the engines were fully loaded during the day period and without a spare unit available, the service has been remarkably free from shut downs.

Central compressed air plant

Description of Engines

These four-cylinder Nordberg Diesel engines, like all other Nordberg designs, are of two-cycle type. They also operate on the full Diesel principle; that is, fuel is injected by means of compressed air. With a bore of 28 in. and a stroke of 44 in., they are rated at 550 hp. per cylinder. This size for a number of years held the record for Diesel engines built in this country. Customary Nordberg practice is again followed in crosshead construction, this being used for the power piston, air compressor, and scavenging pump.

Cylinder scavenging is secured by the valve-in-head system. Experience of this company has proven that this method is thorough and effective for cylinders of this size. All of the larger sizes of Nordberg engines use this method. Each cylinder head is equipped with four scavenging valves symetrically placed, mounted in cages and operated by means of levers actuated from the cam shaft. With the fuel injected, the piston starts its downward travel and the expansion stroke begins. This continues until the piston uncovers the row of exhaust ports near the bottom of the liner, permitting the exhaust gases to escape to the atmosphere. This is the beginning of the exhaust stroke and continues until the piston has reached the lower center and returned on the upper stroke far enough to again cover these ports. Shortly after the exhaust stroke started, however, and when the pressure in the cylinder had been lowered to that of the atmosphere, the scavenging valves are opened and scavenging begins. With the opening of these valves, air at low pressure supplied by the scavenging pump and stored in the scavenging manifold is permitted to blow downward through the cylinder in the form of a solid sheet, thoroughly expelling all gases through the open exhaust ports. Scavenging continues until after the piston has again covered the ports, permitting the pressure in the cylinder to be raised slightly above that of the atmosphere. After the scavenging valves are closed, the compression stroke begins and continues until the piston again reaches the end of the stroke, when the fuel valve is opened, fuel is injected and another working stroke is started. Scavenging valves give little if any trouble, since they are placed in the path of cool air and not subjected to the deteriorating action of exhaust gases.

The bedplate is made in sections, securely bolted together, and upon which is mounted the pairs of frames, each supporting a cylinder. Planed surfaces on the inside of the frames form the crosshead guides, which are assured of being kept cool by the large water jackets in these frames. The cylinder castings are bolted to the frames and in turn bolted to each other, thus securely tying the upper portion of the engine together. In these castings are pressed removable cylinder liners surrounded by spacious water jackets.

Adjacent to the last power cylinder is placed the double-acting scavenging pump, while at the end of the bedplate is the three-stage compressor, each driven by a separate crank on the crank shaft. Nordberg automatic plate valves are used on both the suction and discharge of the scavenging pump. The manifold into which the pump discharges extends the full length of the power cylinders and, being flat on top, serves as an overhead platform.

The main bearing shells resting in the bored recesses of the bedplate are babbitt lined and readily removable with the crank shaft in place. This shaft, like all other Nordberg crank shafts, is of the built-up type consisting of machined "U"-shaped forgings and straight pieces pressed together by a method which, when completed, assures a shaft of correct alignment. The pistons are made of two pieces, a cast-steel head and a cast-iron skirt, and are arranged for water cooling. The piston-cooling water is piped to a set of swinging arms attached to one end of the crosshead pin. The water entering through this set of arms serves to keep the crosshead pin cool. From here the water passes up through the hollow piston rod and into the piston head, where it is caused to circulate and then passes downward through a copper tube connecting the piston head to the opposite end of the piston pin. From here the warm water passes out through another set of swinging arms attached to the other end of the pin. This piston-cooling mechanism is designed and made of such materials that it is leak-proof and requires very little attention, even after long periods of service.

The cam shaft is located overhead, set horizontal and driven by a vertical shaft through spiral gears. The engine is started and operated from above, although it can be shut down from the engine room floor. The air bottles are conveniently placed with respect to the upper platform.

Two forms of lubrication are employed—mechanical force feed and continuous gravity. The former is used for the power and compressor cylinders, while the latter provides lubricant to all other bearings. At the bottom of each cylinder liner is a set of dual wiper rings; one set is to wipe off and collect used cylinder oil and prevent this from falling downward and contaminating oil of the gravity system, the other is to wipe off any oil which may splash up onto the piston from below. Each power cylinder has a separate fuel pump, these being mounted in pairs and driven from the cam shaft. The amount of fuel delivered to any cylinder is controlled by the governor, which acts on the bypass valve, opening it sooner or later, depending upon the load and the amount of fuel required. The exhaust elbows are water jacketed and the exhaust pipe is thoroughly lagged, thereby keeping the radiation from the exhaust pipe to the engine room at a minimum. Although the engine is of open-frame design, suitable splash guards are provided for confining the splash oil, which is an aid in maintaining the clean and tidy appearance of the engines.

Summary of Equipment

Diesel engines, Nordberg Manufacturing Co.

Generators, switchboard, motors and substation equipment, Westinghouse Electric & Manufacturing Co.

Transformers, Pittsburgh Transformer Co.

Pumps, American Marsh Co.

Crane, Harnischfeger Corporation.

Fuel-oil pumps, Viking Pump Co.

Fuel-oil tanks, Graver Corporation.

Spray pond equipment, Cooling Tower Co.

Water tower, Pittsburgh-Des Moines.

Filters, Reed Air Filter Co.

Centrifuge, Sharples Specialty Co.

Valves and fittings, Crane Co.

Floor grating, Arrowhead Co.

Steel framework, Concrete & Steel Construction Co.

Lock-bond tile, United Clay Product Co.

Roof, Johns-Mansville.

ELECTRIC WIRING PROBLEMS IN COAL MINES

One of the biggest problems confronting the safety engineer is how to secure reasonably safe electric wiring in a modern coal mine, points out the United States Bureau of Mines. He is not only confronted with this problem as conditions exist today, but under the urge of still greater mechanization it looms larger and larger in the future. From the standpoint of European mining practice, in general, and British practice in particular, American wiring methods might be considered extremely unsafe.

The Bureau of Mines is continually facing this problem in carrying on its program of testing equipment submitted for approval as "permissible." How to safeguard that portion of mine electric wiring immediately associated with approved equipment is constantly becoming a more difficult question to solve.

Under normal ventilation the wiring offers certain hazards, but mostly minor ones compared with major hazards such as roof falls. However, let ventilation be stopped, or the normal course of the air be diverted and the electric wiring hazards may become major hazards and threaten disaster to the entire mine.

Some of the steps being taken to reduce this hazard are as follows: (1) Manufacturers have adopted rubber air hose for protecting wirings of storage battery locomotives and other machines in place of metal conduit that is easily damaged and weakened as a protection for wires by corrosion and falling objects. (2) Approval plates are now worded to require the proper making and vulcanizing of splices in trailing cables. (3)Fuses or other suitable automatic circuit interrupting devices are also required for protecting of trailing cables. (4) Field and laboratory studies are being made in an effort to discover factors that make for the greatest safety in the constructing of trailing cables.

Even with all this there is still a grave question as to whether trailing cable will ever have as high a degree of safety as a motor or other piece of electrical equipment that has passed the Bureau of Mines' inspection and test.

VENTILATION OF LAKE SUPERIOR COPPER MINES

Although the working zones in the copper mines of the Keweenaw District of the Lake Superior region are now from a half mile to over a mile below the surface, and at depths along the dip of the lodes half again as great, good primary ventilation is produced by natural draft caused by small temperature differences in the shafts and other mine openings. Long development openings require auxiliary mechanical ventilation which is being accomplished by small fans blowing air through canvas tubing. The deepest mines are encountering hot and humid air conditions in the operating zones and are considering fan installations for mechanical primary ventilation to augment the natural flow of air. A recent survey of three deep mines by engineers of the mining division of the United States Bureau of Mines, showed quantities of 40,000 to 100,000 cubic feet of air per minute circulating through working zones at a time when the natural draft was a minimum; and rock temperatures of but 90 degrees F. in virgin ground a mile below the surface.

COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

The APPLICATION *of* ENGINEERING *to* MINE FAN SELECTION

By CHARLES A. CARPENTER *

Constant Water Gauge Impossible — Characteristic Fan Curves Obtainable — Uncalibrated Anemometer Readings Usually Compensated By Leakage—Standard Method Of Air Readings Desirable — Fan Should Maintain Constant Volume At Slight Pressure Changes Without Change Of Speed.

MANY papers and texts have been published touching on various phases of mine ventilation. Most of the literature available on this subject deals with mining problems and not with the specific matter of proper fan selection.

This article is confined to a brief analysis of the flow of air in such passageways as mines and a presentation of basic engineering applied to fans.

Flow of air is influenced by many factors. In the first place, there must be a pressure drop between the point where the air current starts and the point where the air current ceases. A fan is a machine that creates a pressure differential. Even in the case of the simple desk or office fan a depression in pressure pulls air into the wheel on one side and a building up of potential pressure by the blades causes the air to blow away from the fan on the opposite side. It is obvious that power is required even to stir the air in as small a space as an office.

Air flowing through a passageway does not have a uniform velocity. Wall friction causes the air current to lag close to the surfaces of the airway, generally with the effect that the center velocity is considerably above the average velocity.

Bends, splits, and changes in cross section area cause turbulence which of course consumes energy.

The walls of an airway cause a loss by friction that must be overcome by power. Careful scientific tests indicate that loss by friction varies as the square of the velocity of flow, directly as the length of passage and directly as the coefficient of friction.

It has been definitely established that there is a fixed relation between air pressure in inches of water gauge and corresponding velocity in feet per minute for any given temperature, relative humidity and barometer. Here again the pressure varies as the square of the velocity.

The purpose of a fan is to cause air to flow in definite volume at definite places. Leakage between the fan and point of desired air delivery requires the fan to handle the needed volume plus leakage at a higher pressure than necessary for primary ventilation because the increased volume handled causes an increase in velocity through portions of the airway affected with consequent increased friction loss.

In the normal mine a fan, therefore, handles an excessive amount of air at a needlessly high pressure simply as the result of leakage. The fan must develop a pressure differential sufficient to overcome the sum of all friction losses, turbulence losses and final velocity loss.

At this point let us analyze the extreme improbability of a mine remaining for any appreciable time in such condition that the water gauge at the fan would be constant.

In an ordinary mine the length of airways is continually changing. It is desirable to force air to the new working faces. Leakage through shaft curtain walls varies. Variable leakage may occur at the fan setting, etc. Roughness and layout of airways undergo changes. Variable leakage may occur at stoppings and overcasts. Airways may be choked by falls, improper layout, etc. Trips of cars may temporarily block passages. Trips of cages may temporarily block shaft.

Granting that a mine will have a variable water gauge for a definite volume of air delivered at desired points, it is important to consider fundamental operating characteristics of fans. In the first place since pressure losses vary as the square of the velocity and velocity varies with the volume delivered through a fixed airway, it follows that for any instantaneous conditions four times the pressure is needed to cause twice the volume to flow. For any instantaneous condition of a mine, a curve may be developed between volume of air and water gauge. Such a curve is a parabola based on the equation—$Q^2 = ch$; in which "Q" equals cubic feet per minute of air flow; "h" equals water gauge; "c" equals a

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constant depending upon the local conditions. For any other conditions the value of "c" will change.

Following out this thought the parabola of air flow through a mine is changing with every change in conditions mentioned above.

The normal mine fan operates at one or more fixed speeds. For any fixed speed in r. p. m. a fan performs according to a definite relation between volume handled and water gauge developed. Thus at total shut off, no volume passes but a pressure is produced. As air is allowed to pass, the pressure at the fan varies according to a definite curve and by careful tests the characteristic curve of the fan may be obtained.

It is evident that the parabola of air flow intersects the characteristic curve at one point and some other parabola of air flow must intersect the characteristic curve at some other point.

A fan follows the usual laws of science in that the efficiency starts at zero when no air flows, rises to a maximum as air is permitted to flow in increasing volume and then falls off.

Disregarding basic differences in characteristics of fans of different design, it is evident that the first requirement in fan selections is to determine the probable parabolas of air flow so that the fan may be built to perform over its range of good efficiency for such a duration of time as to make the investment economically sound.

Calculating the pressure required to deliver a quantity of air through a mine is largely guess work at present. Much attention has been given to this subject by scientists but the great variation in airway surfaces makes an accurate solution practically hopeless. However, some approximate maximum and minimum pressures may be estimated. Practical judgment may enable some individuals to make a close guess.

Measurement of air and pressure produced by an existing fan on the mine affords better opportunity for accuracy provided due care is taken when test readings are made. The frequently used careless methods now often in vogue when mine fan tests are made simply mislead everybody concerned.

Using an uncalibrated anemometer in an airway gives a vague idea about air flow. Generally such readings give most weight to center velocity and indicate from 20 to 50 percent more air than actually flows. Sometimes this error at the point of reading just nicely balances leakage between the fan and point of air measurement. Sometimes airways are carefully sectioned and average air readings are determined by calibrated anemometer. Such tests may be fairly accurate for the conditions at a particular spot but the fan may be called upon to do much more work on account of leakage.

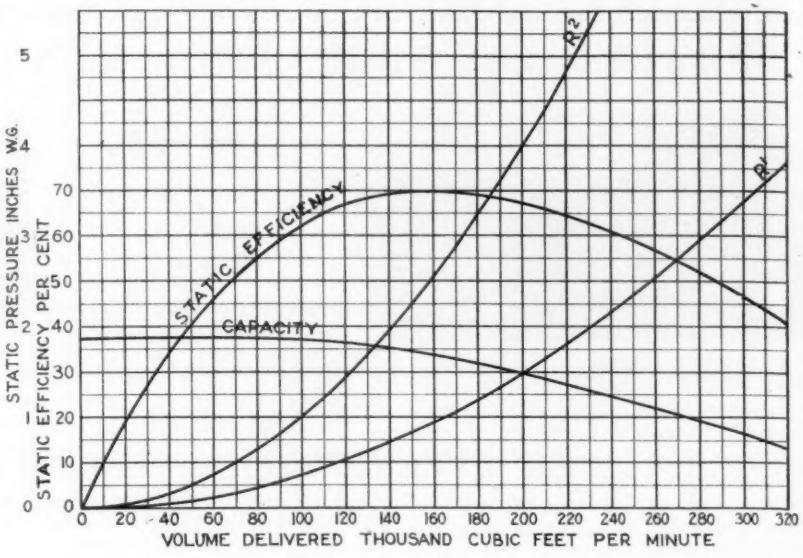

Figure 1

So called "ordinary mine measurement" of varying degree of accuracy when made in mine air courses may, therefore, indicate volumes above, equal to, or below the true capacity of a fan depending upon leakage of air and care in using the anemometer.

We, therefore, find that care and judgment must be exercised in order that even approximate estimates may be made of probable pressure requirements for the passing of a definite volume of air through a mine.

In this connection it is desirable to give some consideration to temperature, barometer and humidity at the time of testing and to estimate the normal value of these three items so that the fan may be designed accordingly.

A most urgent requirement of modern mine ventilation is a proper standard method of taking air readings. The desired method should be scientifically sound, simple to analyze and easy to carry out.

From the evidence above, it is apparent that the usual problem of mine ventilation is somewhat as follows: John Doe has a mine and someone has guessed more or less inaccurately that he needs 100,000 cubic feet of air per minute (the method of air measurement, temperature, humidity and barometer not being given) and it is furthermore guessed that one inch of water gauge (not specifically defined as static or total pressure) will be required. What fan should John Doe buy?

A builder of fans might find it desirable to follow a similar procedure and say Tom Jones has one of our fans on his mine giving 100,000 c. f. m. (method of air measurement, temperature, humidity and barometer not given) and it operates at one inch water gauge (not specifically defined as static or total pressure). This fan shows 75 percent efficiency.

Suppose John Doe buys a duplicate of Tom Jones' fan. Furthermore, suppose John Doe really needs 120,000 c. f. m. at the fan, whereas Tom Jones' fan is actually only delivering 80,000 c. f. m. Furthermore, suppose that differences in barometer, humidity and temperature make the relative pressure comparisons at normal air conditions (70° F., 29.92" Hg and 50 percent relative humidity) .9 inch for John Doe and 1.1 inches for Tom Jones.

The same fan must be capable of delivering 120,000 c. f. m. at .9 inch and 80,000 c. f. m. at 1.1 inches. Tom Jones thinks he has a wonderful fan with an indicated efficiency of 75 percent, but he only gets 80 percent of his inaccurately measured volume. His true efficiency shrinks to 60 percent. Joe Doe buys a fan that is nowhere nearly as good as he thought and it does not fit his mine. Is it surprising that mine fans so frequently do not fit the mine efficiently.

A most urgent requirement of modern fan application is to base fan design on accurate scientific tests making due allowance for all proper correction factors.

Such a standard eliminates inaccuracies from the ratings of fans and has been introduced by many users of fans in their requirements—notably such industries as power plants and large well organized mills.

Assuming that a fan proposed for a mine will actually perform as stated, the error in selecting the proper requirements is confined to the mine itself. This error may be (*Continued on page* 843)

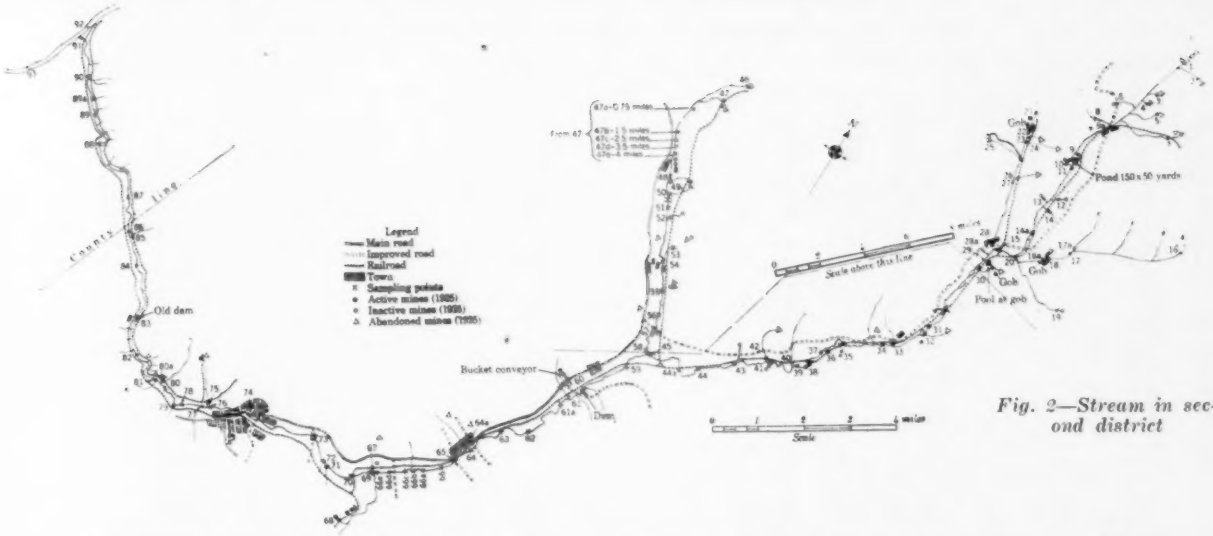

Fig. 2—Stream in second district

OBSERVATIONS *on* ACID MINE DRAINAGE *in* WESTERN PENNSYLVANIA

OBSERVATIONS And Analyses Of Drainage Water From Several Coal Seams — From Working And Abandoned Mines—From Coal Bed And From Gobbed Material—Effect On Surface Streams—Chemical Neutralization

By R. D. LEITCH *

THE pollution of streams has received much attention during the last few years, and although there are many other and more serious forms of pollution, the problem of acid mine drainage is important in certain sections of the country, particularly in Pennsylvania. At the request of the United States Public Health Service, the Bureau of Mines undertook to determine some of the factors contributing to formation of acid mine waters, the yearly variations in quantity and quality of drainage, effect of mining methods, and various other questions arising in connection with the problem; some attention was also given to its economic phases.

Because no data of a like nature had previously been determined, and with the thought that such data would throw additional light on the general subject, a stream having a number of mines draining into it was selected for observation in both high-sulphur and low-sulphur bituminous coal districts, as designated in commercial rating. These mines and streams were visited in both wet and dry seasons to note the quantity and variations in acidity of mine drainage and the subsequent effect on streams. Maps of these streams with the sampling points are shown in figures 1 and 2. In a report of this nature a great deal of tabular data is best omitted, but reference to the maps will serve to indicate the factors that determined sampling points, such as tributary streams and gobs.

DESCRIPTION OF DISTRICTS

A stream about 18 miles in length in southwestern Pennsylvania, having 17 active, 6 inactive, and 2 abandoned mines draining into it in 1925, was selected for the low-sulphur-bearing coal beds; this area is hereafter referred to as the "first district." A similar stream, approximately 35 miles long, was selected in the northwestern part of Pennsylvania, in a high-sulphur-bearing coal field, but had only seven active mines along its length in 1925. There were 7 inactive and ap-

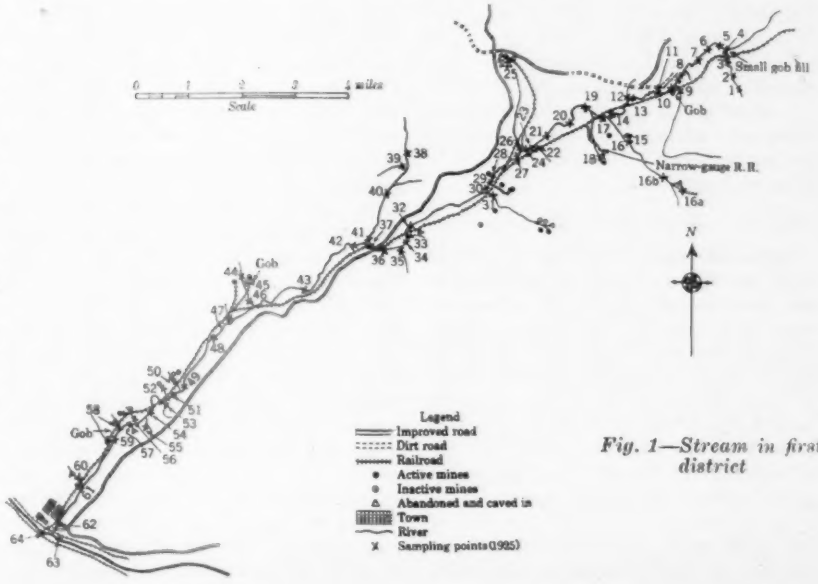

Fig. 1—Stream in first district

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TABLE I—TABULAR DESCRIPTION OF MINES AND MINE DRAINAGE IN DISTRICT No. 1

Mine No.	Kind of mine	Production tons per day	Drainage thousands of gallons per day	Drainage	Tons water per ton of coal	Total acidity p. p.m.	pH	Work: Retreat, percent	Work: Advance, percent	Work: Pillars drawn	Bottom: Average cover, feet	Bottom: Hard	Bottom: Soft	Age yrs.	Probable life	Remarks
1	Slope	300	†43	Natural	....	14,484	*3.2		100	Yes	250	x		17	?	Work on order.
2	Drift	350	†30	Natural	....	1,941	*3.2	50	50	Yes	100	x		12	?	Work on order.
3	Abandoned shaft	...	†3,402	Pump	22.3	827	*3.2	...	...	No	120	x		..	..	Water from 4 mines—2 abandoned.
4	Drift	300	58	Pump	0.8	106	5.2		100	No	90	x		8	30	
5	Drift	125	50	Natural	1.7	46	*3.2		100	Yes	60	x		8	30	Inactive 2 years—Work on order.
6	Drift	50	158	Natural	13.2	118	*3.2		100	No	130	x		9	?	Work on order.
7	Drift	25	43	Natural	7.2	592	*3.2		100	No	150	x		50	?	Work on order.
8	Drift	...	36	Natural	....	286	*3.2	100, if worked		Yes	110	x		55	..	Inactive 12 years—abandoned.
9	Drift	100	29	Natural	1.2	2,260	*3.2	50	50	Yes	40		x	40	4	Work on order.
10	Drift	75	45	Natural	2.4	838	*3.2	100		Yes	40		x	9	1	Work on order.
11	Drift	125	21	Natural	0.7	33	6.2		100	No	60	x		9	45	Inactive.
12	Drift	250	50	Natural	0.8	55	6.1	40	60	Yes	60		x	9	5	Work on order.
13	Drift	100	72	Natural	3.0	446	*3.2		100	Yes	90	x		8	60	Work on order.
14	Drift	50	None	Natural	....	.....	6.8	5	95	Yes	50		x	8	?	Work on order.
15	Drift	...	None	Natural	....	.....	*3.2		100	No	80		x	8	..	Abandoned.
16	Drift	15	None	Natural	....	.....	*3.2	100		Yes	60		x	8	?	Work on order.
17	Drift	20	40	Natural	8.3	141	*3.2		100	No	40	x		8	200	Work on order.
18	Drift	20	22	Natural	4.6	80	5.0		100	No	90	x		5	150	Inactive.
19	Drift	25	28	Natural	4.7	11	5.9		100	No	50	x		2	65	Work on order.
20	Drift	50	15	Natural	1.3	98	5.0	95	5	Yes	80	x		30	20	Inactive.
21	Slope	500	18	Pump	0.2	772	4.0		100	No	130		x-limestone	17	50	Work on order.
22	Drift	50	25	Pump	2.1	38	5.9		100	No	120		x	17	650	Work on order.
23	Drift	50	15	Natural	1.3	313	*3.2		100	No	50	x		8	20	Work on order.
24	Drift	150	108	Natural	3.0	650	*3.2	100		Yes	200	x		30	?	Work on order.
25	Drift	50	50	Natural	4.2	1,244	*3.2		100	No	140	x		7	?	Inactive 4 years.

* Less than 3.2.
† Total from 4 mines can not be separated definitely.

TABLE 2—TABULAR DESCRIPTION OF MINES AND MINE DRAINAGE IN DISTRICT NO. 2

26	Drift	900	482	Pump	2.2	3,100	*3.2	10	90	Yes	200		x	25	?	Work on order.
27	Drift	550	288	Pump	2.2	991	*3.2	5	95	Yes	160		x	19	?	Work on order.
28	Drift	100	7	Natural	0.3	3,350	*3.2	100		Yes	80		x	8	1	
29	Drift	400	160	Pump	1.7	523	*3.2		100	Yes	120		x	11	?	Work on order—2,000 acres
30	Drift	400	30	Pump	0.3	125	5.6		100	No	70	x		8	?	Work on order.
31	Drift	700	400	Pump	2.4	145	4.0	10	90	Yes	110	x		9	?	Work on order.

proximately 15 abandoned mines; most of the latter were caved shut with no water coming from them, so far as could be determined. This area will be called the "second district." Both districts are rugged, the yearly rainfall somewhat more than the average for the state, and the run-off rapid. Heavy local rains quickly caused flooding of streams in both districts, although subsidence is almost as rapid. Both streams head in several small springs, and numerous very small tributaries enter throughout the lower half of their length. The tributaries effect no noticeable change in the main stream, except that a gradual decrease in acidity is apparent; this effect is ascribed to dilution, because the stream bottom is sandstone and apparently can have no neutralizing effect.

Types of Mines and Coal Formations

With three exceptions—one abandoned shaft and two slope mines—all mines in the first district were drift mines; all were drift mines in the second district. Cover in the first district is from 40 to 250 ft. thick and in the second district is from 70 to 200 ft. thick; strata is more broken, with consequent increased penetration by surface waters, in the second district. The mines are uniformly small, normal production varying from 15 to 500 tons a day in the first district and from 100 to 900 tons in the second district. In most of the mines the bottom is fireclay and the roof is shale.

According to local information, seven different coal beds are being worked in the first district; the Lower, Middle, and Upper Kittanning, the Lower and Upper Freeport, the Pittsburgh, and the Sewickley. The last-named bed is found in only three of the mines highest in elevation (about 2,300 ft.) and is not of much importance in this study. More than half of the mines are working the Lower Kittanning; this bed and the Upper Kittanning are the most important beds. The coal varies in thickness from 22 in. to 6 ft., and is largely used as steam coal. It is generally friable and clean, except for thin parting bands and a few sulphur streaks, and is sold as run of mine. The coal outcrops near the headwaters of the stream on which the mines are situated. These mines are from 1,800 to 2,300 ft. above sea level and are known as dry mines, although heavy rains in spring and fall seasons change conditions somewhat.

Drainage volumes are not easily determined in these mines; the drift mines are being worked to the rise, which causes water to flow out by gravity. Few pumps are used, except the gathering pumps in some low sections. The data show that an average of 4.5 tons of water comes from these mines per ton of coal removed in a normal dry season, with a variation from 0 to 22 tons of water per ton of coal. The high figure is due to the fact that all drainage from two active and two abandoned mines is pumped from one abandoned mine; therefore water comes from four mines, only two of which produce any coal. A normal fall wet season is said by mine foremen of the district to increase drainage volumes generally about one-third.

Mines in the second district are very similar to those just described; the coal, however, is of a lower quality, and the beds worked are the Lower Kittanning and Upper Freeport. The country is somewhat more rugged, there are fewer mines, and the streams are somewhat larger. A great many more abandoned mines are to be found, although they are generally caved shut and water is flowing from only about half of the total number in the wet season. As the coal is of rather low value, it is not in general demand, and any estimates of drainage volumes per ton of coal are so affected by the local coal markets that they are likely to be very inaccurate. The average in the fall of 1925 was 1.7 tons of water per ton of coal, but a period of continuous idleness during 1926, totaling seven months, will more than double the figure for that year. Table 1 gives a summarized description of mines in the first district and Table 2 of those in the second district.

According to standard methods of water analysis "acidity, p. p. m." is that number of parts per million of calcium carbonate which would neutralize the acidity of the water in question. Under "Total acidity, p. p. m." in the tables, the

TABLE 3—OUTFLOW FROM MINES IN FIRST DISTRICT*

Mine No.	Season†	Total acidity	Acidity cold	Free acidity‡	pH
	A	1,970	1,734	252	‖3.2
1	B	.....	827	134	3.6
	C	14,484	2,102	433	‖3.2
	A¶	2,297	1,832	438	‖3.2
2	B	.....	827	134	3.6
	C¶	793	713	233	‖3.2
	A	347	315	166	‖3.2
3§	B	.....	827	134	3.6
	C	454	320	156	‖3.2
	A	575	450	299	‖3.2
4	B	.....	64	Alk. 33	...
	C	568	484	284	‖3.2
	A	166	118	63	‖3.2
6	B	.....	118	29	‖3.2
	C	125	96	96	‖3.2
	A		Closed		
7	B	.....	592	60	‖3.2
	C	389	1,196	60	‖3.2
	A		Closed		
8	B	.....	332	87	‖3.2
	C	1,251	343	93	‖3.2
	A		No water		
9	B	.....	2,260	113	‖3.2
	C¶	2	21	Alk. 113	7.6
	A	20	40	Alk. 190	6.1
10¶	B	.....	837	72	‖3.2
	C		No water		
	A		Not working		
11¶	B	.....	24	Alk. 147	6.3
	C		Not working		
	A	16	12	Alk. 25	6.6
12	B	.....	7	Alk. 39	6.1
	C	19	19	Alk. 76	6.6
	A	276	185	118	‖3.2
13	B	.....	446	60	‖3.2
	C	491	350	178	‖3.2
	A			No water	
14¶	B	.....	10	Alk. 11	5.5
	C	0	43	Alk. 25	6.8
	A	877	592	355	‖3.2
16	B	.....	808	378	‖3.2
	C	1,200	930	114	‖3.2
	A	79	55	48	4.0
17	B	.....	129	37	‖3.2
	C	415	270	193	‖3.2
	A¶	299	213	134	‖3.2
18	B	.....	54	Alk. 91	4.2
	C¶	193	145	135	‖3.2
	A			Not working	
19	B	3	27	Alk. 20	5.9
	C			Not working	
	A	106	62	30	‖3.2
20	B	132	108	11	‖3.2
	C	102	39	56	3.7
	A	1,418	946	513	‖3.2
21	B	.....	771	17	4.0
	C	845	672	67	‖3.2
	A	51	20	Alk. 20	4.4
22	B	.....	38	Alk. 39	5.9
	C	0	14	Alk. 50	6.2
	A¶	422	217	148	‖3.2
23	B	487	388	Alk. 88	‖3.2
	C¶	1,095	720	154	‖3.2
	A¶	909	599	332	‖3.2
24	B	527	498	10	‖3.2
	C¶	1,318	778	244	‖3.2

* Acidity expressed as parts per million.
† A, November, 1926; B, August, 1925; C, August, 1926.
‡ Alk., alkalinity.
‖ Less than 3.2.
¶ Average of samples in mine.
§ Mixture of all water from four mines, two abandoned.

TABLE 4—OUTFLOW FROM MINES IN SECOND DISTRICT*

Mine No.	Season†	Total acidity	Acidity cold	Free acidity‡	pH.
26	A	907	658	331	‖3.2
	B	3,550	3,604	182	‖3.2
27	A	247	181	132	‖3.2
	B	1,044	991	85	‖3.2
28¶	A	817	666	272	‖3.2
	B	8,221	4,669	413	‖3.2
29	A	33	37	Alk. 40	6.2
	B	71	19	0	5.6
30¶	A	49	25	Alk. 108	5.7
	B	41	49	Alk. 84	5.1
31	A	236	150	87	‖3.2
	B	2,480	2,020	684	‖3.2
‖	A	868	647	260	‖3.2
	B	214	Alk. 203	Alk. 11	4.4

* Acidity expressed as parts per million.
† A, November, 1926; B, November, 1925.
‡ Alk., alkalinity.
‖ Less than 3.2.
¶ Average of samples in mine.
§ Abandoned mine 6 miles up right branch.

TABLE 5—ACIDITY OF DRIPPERS IN VARIOUS MINES*

Mine No.	Sample	Date	Total acidity	Cold	Free acidity	pH
	2	7-1-25	..	148	46	4.6
1	2	7-13-26	0	36	†100	6.6
	60	10 13-26	0	24	†130	6.3
10	7	7-24-25	..	14	†106	...
9	4	7-24-25	..	10	†12	4.6
	12	7-24-25	0	28	†300	9.0
13	61	7-16-26	0	64	†186	7.0
	50	10-19-26	0	28	†103	6.5
7	6	7-26-25	..	†18	†91	6.8
17	13	8-3-25	..	6	†125	6.4
18	2	8-4-25	..	27	†237	6.6
19	4	9-25-25	0	8	†48	7.0
27	8	10-22-25	0	9	†87	6.8
29	8	11-5 25	9	0	†118	5.0
	5	11-26-26	33	33	†70	6.4

* Acidity expressed as parts per million.
† Alkalinity.

TABLE 6—SAMPLES FROM FACES OF ENTRIES IN FIRST DISTRICT*

Mine No.	Sample	Date	Total acidity	Cold	Free acidity	pH
	60	10-14-26	528	394	244	*3.2
2	18	7-14-26	923	497	71	†3.2
	1	7-14-26	568	533	64	†3.2
4	41	10-15-26	‡1,418	‡1,498	‡710	††3.2
	5	7-14-26	217	224	185	†3.2
14	12	7-29-25	...	7	‖12	6.8
	81	7-26-26	0	71	‖20	7.2
15	5	10-21-26	‡2,325	‡1,639	‡1,031	‡3.2
21	8	8- 6-25	...	24	‖163	3.4
	1	7-24-26	....	130	43	†3.2
	4	8- 6-25	‡778	‡547	‡58	††3.2
	6	8- 6-25	...	178	‖14	†3.2
18	7	8- 4-25	...	55	‖173	5.0
19	13	9-25-25	0	8	‖57	7.0

* Acidity expressed in parts per million.
† Less than 3.2.
‡ Old entries; pools on floor at face.
‖ Alkalinity.

TABLE 7—SAMPLES FROM FACES OF ENTRIES IN SECOND DISTRICT*

Mine No.	Sample	Date	Total acidity	Cold	Free acidity	pH
26	3	10-20-25	20	95	‡54	4.2
	31	11-18-26	47	79	‡16	6.0
	16	10-20-25	31	14	47	†3.2
	22	11-18-26	1,048	424	158	†3.2
	41	11-18-26	0	32	‡110	6.6
28	6	11-21-26	...	‖1,645	‖346	††3.2
29	22	11- 5-25	25	16	‡182	5.4
	15	11-26-26	0	33	‡17	6.4
	21	11- 5-26	22	12	‡91	5.8
	9	11-26 26	0	16	‡85	6.4
30	22	11- 9-25	16	0	‡84	6.0
	12	11- 9-25	28	0	‡111	5.4
	9	12- 9-26	4	4	‡80	6.4
	9	11- 9-25	31	0	‡180	6.8
	19	12- 9-26	41	8	‡145	6.2
	7	11- 9-25	50	6	‡133	5.4
	5	12- 9-26	147	82	33	3.7
	15	12- 9-26	4	4	‡100	6.4

* Acidity expressed in parts per million.
† Less than 3.2.
‡ Alkalinity.
‖ Old entry: pool on floor at face.

TABLE 8—SAMPLES FROM ABANDONED SECTIONS IN FIRST DISTRICT*

Mine No.	Sample	Date	Total acidity	Cold	Free acidity	pH
1	1	7- 1-25	...	138	37	4.6
	8	7-13-26	18	36	‡12	5.9
	8	10-13-26	71	71	‡50	3.6
	3	7- 1-25	...	567	100	3.8
	1	7-13-26	724	667	227	†3.2
	11	10-13-26	1,024	747	559	†3.2
2	2	7-14-26	302	511	298	†3.2
	19	7-14-26	1,377	1,331	497	†3.2
4	12	7-14 26	369	327	99	†3.2
	19	10-15-26	568	410	299	†3.2
12	2	7-23-26	15	39	‡15	7.4
	19	10-20-26	16	24	‡50	5.2
13	19	10-19-26	512	296	198	†3.2
6	8	7-29-25	...	135	57	†3.2
	3	10 27-26	229	173	102	†3.2
	12	7-29-25	...	25	‡21	6.2
	50	7-24-26	202	125	67	†3.2
	22	10-27-26	351	237	138	†3.2
	15	7-29-25	...	28	‡54	6.3
7	3	7-26-25	...	232	60	†3.2
	41	7-28-26	595	2,130	72	†3.2
	1	7-26-25	....	654	97	†3.2
15	50	10 21-26	1,222	1,025	449	†3.2
17	4	8- 3-25	...	33	‡15	5.7
	22	7-22-26	0	0	‡43	6.4
	50	10-21-26	19	20	‡101	7.1
15	13	7-26-26	10,473	9,088	391	†3.2
	6	10-21-26	1,497	1,222	331	†3.2
22	31	7-28-26	374	221	86	†3.2
21	12	8- 6-25	...	1,090	129	†3.2
24	3	8-11-25	1,024	981	58	†3.2
	5	10-23-26	158	126	95	†3.2
	2	7-28-26	192	163	58	†3.2
	13	8-11-25	1,050	970	115	†3.2
	3	10-23-26	426	276	181	†3.2
	16	8-11-25	3	25	‡47	...
	3	8-11-25	...	1,548	736	†3.2
	61	7-28-26	1,690	1,392	500	†3.2
	9	8-11-25	...	232	117	†3.2
	4	7-28-26	1,075	980	115	†3.2
	31	10-23-26	1,132	819	504	†3.2

* Acidity expressed in parts per million.
† Less than 3.2.
‡ Alkalinity.

value represents the total amount of acid which may be formed from the iron salts held in solution plus the free sulphuric acid which is already there. In other words, it is potential acidity.

By "pH" is meant the extent to which free hydrogen (H) ions are present in solution. By trial, neutral water has been found to have a value of 7.0. Any numbers less than 7, as 3.5, 4.6, and so on, represent an acid condition, and numbers greater than 7, for example 7.6, 8.1, and so on, indicate a condition of alkalinity. These numbers are the logarithms of the reciprocals of the normality of H ions in solution. As the numbers decrease below 7.0, the acidity increases to the extent that there are 10 times as many H ions in a solution of pH=6.0 s in one of pH=7.0, and 10 times as many in one of pH=5.0 as in one of pH=6.0, or 100 times as many as in the one where pH=7.0. The pH, or hydrogen-ion values therefore definitely indicate whether or not one acid solution will be found more active than another, although they may be of the same strength according to titration values. For example, N/10 hydrochloric acid has a pH value of 1.04, whereas N/10 acetic acid has a pH value of 2.86 (at 18°), but the former is nearly 70 times as strong in effect as the latter.

Method of Conducting Tests

As already stated, there is usually a spring and fall wet season and a dry summer season. Data were gathered in the first district for two summer seasons and for one fall season during which conditions were about average, and for two fall seasons in the second district; early snows in 1925 and unusual rains in August, 1926, prevented the determination of dry-season data.

Sampling

The streams were sampled at regular intervals of about one-half mile, unless entering streams or unusual conditions warranted more frequent samples. In the second district these intervals were increased to about 1 mile; little, if any, change was evident throughout the last 12 miles, as there were no mines in this distance and only three tributary streams of appreciable size, although there were a great many small ones.

At the mines visited, efforts were made to obtain samples from all places where different kinds of waters were found—that is, from fresh working faces or active and abandoned entries—and from drippers or any special sources that came to notice. Tables 3 to 10 at the end of this report give the findings from these samples.

Acidity Determinations

Three acidity determinations were made on each sample according to standard methods[3] of water analyses, except for a modification found necessary by Selvig and Ratliffe,[4] when determining free mineral acids in most mine waters. A hydrogen-ion determination was made on each sample with an outfit developed for field use which utilizes prisms containing the acid and alkaline colors of suitable indicators, and compares these with the sample until a color match is obtained. Total acidity is commonly determined in cold solutions, using phenolphthalein as indicator, but nearly all mine waters give a higher value at boiling temperature from hydrolysis of iron salts. This value is called "total acidity" hereafter, because as these salts hydrolyze, a corresponding amount of free acid is liberated and the measure of acidity of mine waters is properly that maximum value which is the potential power of subsequent damage by these waters.

Stream Flow

A portable V-notch weir was used on nearly all streams that were not too large to be measured in this way. In these weirs, surface velocity was determined by timed floating sticks and average cross section of the stream; a factor of 0.83 was multiplied by the average surface velocity to obtain average velocity of the section. According to Kent (Mechanical Engineers Pocket Book, 10th edition, 1923), this method gives a close approximation to measured volumes. In mines, because of the difficulty of so measuring these streams, the weir measurements were not made, and estimates of the volume were usually given by mining men or by the writer. It is very difficult to arrive at an accurate value by this method, however.

[3] Standard Methods of Water Analysis, A. P. H. A., 1920, 4th ed.

[4] Ind. and Eng. Chem., vol. 14, No. 2, February, 1922, p. 125.

TABLE 9—SAMPLES FROM ABANDONED SECTIONS IN SECOND DISTRICT*

Mine No.	Sample	Date	Total acidity	Cold	Free acidity	pH
26	20	10-20-25	3,087	2,842	218	†3.2
	2	11-18-26	907	658	331	†3.2
	9	10-20-25	9,520	9,561	326	†3.2
	2	10-20-25	3,550	3,604	182	†3.2
	60	11-18-26	1,773	1,497	414	†3.2
27	7	10-22-25	379	419	96	†3.2
	50	11-22-26	247	181	132	†3.2
	1	10-22-25	14,537	10,654	559	†3.2
28	2	10-28-25	15,664	19,768	1,602	†3.2
	60	11-21-26	4,190	3,785	1,715	†3.2
	4	10-28-25	2,439	1,905	381	†3.2
	5	11-21-26	675	165	115	†3.2
	3	10-28-25	2,118	2,154	370	†3.2
	19	11-21-26	657	657	264	†3.2
29	12	11- 5-25	1,648	923	479	†3.2
	50	11-26-26	1,151	820	247	†3.2
31	4	11-26-25	2,480	2,020	684	†3.2
	2	11-17-26	236	150	87	†3.2

* Acidity expressed in parts per million.
† Less than 3.2.

TABLE NO. 10—AVERAGE TOTAL ACIDITIES OF ALL MINES, PARTS PER MILLION

Mine No.	Drippers	Active Sections	Abandoned Sections
1	0	....	458
2	..	673	840
4	..	217	464
7	0	....	595
13	0	....	512
15	..	2,325	5,985
17	0	....	6
18	0	55	....
21	..	547	1,090
27	0	....	5,054
28	..	1,645	4,760
29	21	24	1,400

Discussion of Results

Condition of Stream in First District

The stream in the first district has its source about 1½ miles above the first mine and should be alkaline, as unpolluted streams nearly always are. Titration values verified this, as the water was slightly alkaline at boiling temperatures; at no time, however, did the H-ion indicator show a value of 7, which is accepted as indicating neutral water, or higher which indicates alkaline water. Whether this condition may be due to organic acids from decaying plant matter about the source or whether acid-forming matter is leached out of the soil is not apparent. Certain it is that the slight acidity is not due to bicarbonates or dissolved carbon dioxide, because titrations in hot and cold solutions do not show this to be the cause. The acidity is very slight, usually 6.4 to 6.8. About a mile below the entrance of acid water (less than 3.2) from the first mine, the stream recovers sufficiently for aquatic life to be apparent for several hundred yards, just to the point of entry of water (4) from the next mines; from here on the frequent addiiton of acid water evidently makes fish life impossible. Strange to say, however, in 1926 the acid condition of the water was slightly improved over that of 1925, and yet no signs of life could be observed. There is little difference in acidity of samples from the point where this drainage enters the stream to the mouth some 12 miles below; natural streams and acid mine drainage about balance to maintain a rather constant quality of water. The river into which the stream empties is of almost the same acidity because of the coal mines near its source and also throughout its length, so that the entry of the stream does not make any great change, although its effect is readily detected.

Acidity of Mine Waters

Mine samples (see tables 3 to 10 at end of report) showed wide variations in acidity, but consistently indicated that drippers and samples from fresh working faces were with one exception almost invariably alkaline or faintly acid because of the presence of bicarbonates or dissolved carbon dioxide in the water. On the other hand, water from inactive or abandoned sections was almost invariably acid to a degree determined largely by the period that the sections had been idle.

Acid Water from Gobbed Material

Gobbed material, both inside and outside the mines, is undoubtedly an important source of acid water; but whether the practice is to gob rock and high-sulphur coal inside or outside the mine, the general acidity of the water from the different mines does not show appreciable differences. Outside gob piles are under the most favorable conditions for liberating acid, more so than if the gob material were inside; therefore, it seems that less damage would be done if the acid-forming wastes were left inside. If gob material could be placed in dry sections of the mine and sealed off to exclude air, the minimum formation of acid might be expected.

Effect of Limestone Floor on Mine Water

Water from mines having a limestone floor would be expected either not to be acid or at least to be less so than water from mines in the same district not having a limestone floor. No marked difference has so far been observed in

such waters, probably because after a short time the drainage channels become coated with iron oxide which adheres tenaciously to the stone and protects it from contact with the water. Some active mines do not have acid water, but why this is so has not yet been determined. Four mines working the C Prime bed near the district investigated are said not to have acid water, and study of these mines may result in discovery of why it is true. The C Prime bed is underlain by limestone, and although the water is less acid than in some others, it is nevertheless acid.

Character of Water Issuing from Coal Bed

Although so far no water has been observed coming through the coal bed, there are indications that it may do so gradually and thus carry out of the coal the sulphur which is in proper form to become water-soluble. The condition in one mine near the headwaters of the stream in the second district serves as an example; in this mine mixed crystals of ferrous and ferric sulphate in about equal proportions are formed on the ribs to such an extent that abandoned sections and even rooms, according to the superintendent, are eventually filled completely with these salts. These extreme conditions were not actually observed by the writer, but a sample was taken from an entry in which the solid salts were present in sufficient quantity to be shoveled from the floor near the ribs. These salts were unusually pure and were dry and loose. It seems obvious that the iron sulphates must have been carried in solution along cleavage planes in the coal to solidify later on the coal face by evaporation of the water. When dissolved solids are not present to this degree, therefore, the fact that water does come through the coal is quite likely not to be recognized because it works out so slowly as not to be observable. There are numerous small streams, often barely discernable, in fresh working sections, but their exact source can not be determined with certainty. They apparently originate as moisture on the floor. Part of this water may come directly from the coal, but some of it, no doubt, results from contact between warm outside air and the cooler surface of the coal as the air passes through the mine in the ventilating current.

Effect of Sulphur-Bearing Coal on Acidity of Water

Water from high-sulphur-bearing coal beds is more acid than that from low-sulphur beds. A comparison of the two districts illustrates this fact, but in passing it may be well to repeat that strata overlying the beds in the second district were more generally broken than in the first district. In one way this condition might tend to lower the acidity and increase the volume of water, but it seems that any such tendency has been overbalanced by increased contact with acid-forming bodies.

Quality of Water from Abandoned Mines

Abandoned workings are known to have given off water of approximately the same quality and quantity up to at least 15 years after being abandoned. The writer knows of an abandoned mine which has been giving off highly acid water for 45 years to date; no caving has yet occurred in this mine. Four others exhibit the same characteristic after having been abandoned 35 years. Twenty-five abandoned workings showed about the same acidity as eight active mines in the second district, but in the first district seven abandoned mines showed only about one-half the acidity of the other 17 active mines.

Seasonal variations play an important part in the effect of mine drainage on streams. The maximum stream volume at flood stage in such localities as those studied may be many times the average volume because of the rapid run-off. Heavy rains of short duration, therefore, dilute the water to the extent that it may be considered harmless; mine drainage is not increased unless slower soaking rains occur. On the other hand, at periods of low water, usually in August or early September, the stream volume may be, and often is, almost entirely mine drainage.

Effect of Acid on a Natural Stream

So far little opportunity has been afforded for observing the effect of a definite quantity of acid in streams. With one exception, the entry of drainage from successive mines resulted in building up an acidity which decreased only slightly until the stream entered a small river. From the headwaters down to the first mine in the exceptional stream, the volume was estimated to be 700 gallons per minute and alkaline to the extent of 20 parts per million, although the H-ion indicator showed only 6.6, or slightly acid. However, at this point a stream of mine drainage entered having a total acidity of about 100 parts per million, an H-ion value of 3.8, and a volume of about 300 gallons per minute. This resulted in a mixture having a total acidity of 28 parts per million and an H-ion value of 4.

No further additions of mine water took place in the stream for about 1½ miles, although two small alkaline streams of approximately 2 to 3 gallons per minute and a pH value of 7.5 and 7.6 entered in this distance. During the 1½ miles dilution and neutralization took place which resulted in natural recovery to a condition of very slight acidity as determined with phenolphthalein, of an alkalinity of 24 parts per million as determined with methyl orange, and with an H-ion value of 6.5. Small creek minnows and crayfish were observed for some distance until the entry of drainage from four mines, after which the stream had no opportunity to recover. Although no mine drainage entered the stream in the second district for the last 10 miles of its length, the total acidity decreased only from somewhat more than 100 parts per million and a pH value of less than 3.2 to slightly less than 50 p. p. m. This change may be largely accounted for by dilution; the main stream was of large volume, but innumerable very small streams entered throughout this distance so that the volume increased about one-third and the final pH value was 3.9.

Chemical Neutralization of Mine Water

At the present time there seems to be no solution of the problem of stream pollution other than that of chemical neutralization. Two general methods might be used to treat large volumes of water; one of these is to feed ground limestone or lime to the raw water, using a baffled flume to mix the lime well, and then permitting the water to flow into natural or artificial settling basins of sufficient capacity to retain the water for four to five hours. During this time the hydrated oxides of iron will settle out and the effluent water will be neutral or alkaline, somewhat harder, but almost clear, and harmless for most purposes if the treatment is carefully controlled. Of the methods now in use this is the cheapest in first cost and the most simple in operation, but leaves the sludge as a material too thin to shovel and too thick to pump. Its subsequent removal and disposal is likely to prove as much of a problem as the original acid neutralization now appears to be.

One company has used a process which at least results in an oxide of a form easily handled. After being mixed the water travels through a Dorr thickener to a settling tank, and is finally sprayed on a revolving iron drum heated sufficiently to dry the film of oxide sprayed on it in less than one revolution; this is scraped off at the end as a dry yellow powder. The cost of this plant is said to be about $32,000, and its capacity 1¼ to 2 1/3 million gallons of water per day; 13 to 19 tons of oxide were recovered at a cost ranging (*Continued on page* 848)

SAFEGUARDING ELECTRICAL EQUIPMENT USED *in* GASSY MINES

By L. C. ILSLEY *

DURING the summer of 1927 the writer had the privilege of visiting the mine safety testing stations in Great Britain, Belgium, Germany, and France, in the order named. All of these countries have large coal mines, many of which are rated as gassy. Therefore, when the installation of electrical equipment is contemplated, each of these countries is confronted with the same safety problem as in the United States—the development of electrical equipment that will not ignite gassy mine atmospheres, should such atmospheres through neglect or accident surround the equipment. The means used by those countries in safeguarding gassy mines should therefore be of general interest to safety engineers in American coal mines, and it is proposed to give a brief survey for each of the four countries mentioned. The first of these surveys will cover conditions in Great Britain.

REGULATION BEARING ON SAFETY

A good beginning may be made by mentioning some of the requirements found in "Coal Mines Act, 1911." This act includes a section, "General Regulations As to the Installation and Use of Electricity," from which the following pertinent paragraphs have been abstracted:

(125)—(c) All joints in earth conductors and all joints to the metallic covering of the cables shall be properly soldered or otherwise efficiently made, and every earth conductor shall be soldered into a lug for each of its terminal connections. No switch, fuse, or circuit breaker shall be placed in any earth conductor.

(131)—(a) Every person appointed to work, supervise, examine, or adjust any apparatus shall be competent for the work that he is set to do. No person except an electrician or a competent person acting under his supervision shall undertake any work where technical knowledge or experience is required in order adequately to avoid danger.

(131)—(b) An electrician shall be appointed, in writing, by the manager to supervise the apparatus. If necessary for the proper fulfillment of the duties detailed in the succeeding paragraphs of this rule, the manager shall also appoint, in writing, an assistant or assistants to the electrician.

Regulations For Safety In British Mines Covering Construction, Use And Inspection Of Equipment—Requirements For Electric Motors—Specifications And Tests For Flame Proof Enclosures

(131)—(c) The electrician shall be in daily attendance at the mine. He shall be responsible for the fulfillment of the following duties, which shall be carried out by him or by an assistant or assistants duly appointed under paragraph (b): (i) the thorough examination of all apparatus (including the testing of earth conductors and metallic coverings for continuity) as often as may be necessary to prevent danger; and (ii) the examination and testing of all new apparatus, and of all apparatus re-erected in a new position in the mine before it is put into service in the new position.

Provided that in the absence of the electrician for more than one day the manager shall appoint, in writing, an efficient substitute.

(131)—(d) The electrician shall keep at the mine a log book made up of daily log sheets kept in the form prescribed by the Secretary of State. The said log book shall be produced at any time to an inspector of mines on his request.

(131)—(e) Should there be a fault in any circuit the part affected shall be made dead without delay, and shall remain so until the fault has been remedied.

(131)—(f) All apparatus shall be kept clear of obstruction and free from dust, dirt, and moisture, as may be necessary to prevent danger.

Inflammable or explosive material shall not be stored in any room, compartment, or box containing apparatus, or in the vicinity of apparatus.

(131)—(g) Adequate precautions shall be taken by earthing or other suitable means to discharge electrically any conductor or apparatus, or any adjacent apparatus if there is danger therefrom, before it is handled, and to prevent any conductor or apparatus from being accidentally or inadvertently electrically charged when persons are working thereon. While lamps are being changed the pressure shall be cut off.

Provided that this paragraph shall not apply to the cleaning of commutators and slip rings working at low or medium pressures.

(131)—(h) The person authorized to work an electrically driven coal cutter or other portable machine shall not leave the machine while it is working, and shall, before leaving the working place, ensure that the pressure is cut off from the flexible trailing cable which supplies such coal cutter or other portable machine. Trailing cables shall not be dragged along by the machine when working.

(131)—(i) Every flexible cable shall be examined periodically (if used with a portable machine, at least once in each shift by the person authorized to work the machine), and if found damaged or defective it shall forthwith be replaced by a spare cable in good and substantial repair. Such damaged or defective cable shall not be further used underground until after it has been sent to the surface and there properly repaired.

(132) In any part of a mine in which inflammable gas, although not normally present, is likely to occur in quantity sufficient to be indicative of danger, the following additional requirements shall be observed:

(132)—(i) All cables, apparatus, signaling wires, and signaling instruments shall be constructed, installed, protected, worked, and maintained, so that in the normal working thereof there shall be no risk of open sparking.

(132)—(ii) All motors shall be constructed so that when any part is live all rubbing contacts (such as commutators and slip-rings) are so arranged or enclosed as to prevent open sparking.

(132)—(iii) The pressure shall be switched off apparatus forthwith if open sparking occurs, and during the whole time that examination or adjustment disclosing parts liable to open sparking is being made. The pressure shall not be switched on again until the apparatus has been examined by the electrician or one of his duly appointed assistants, and the defect (if any) has been remedied or the adjustment made.

Some of the outstanding features of the rules just quoted that have a chief bearing in maintaining electrical safety are:

(1) Strict rules with respect to giving notice to the Mines Department of intention of installing new equipment.

(2) Strict rules regarding the earthing (grounding) of all equipment and wiring.

(3) Instructions for selection of the electrician and other workmen, with the requirement that the electrician must be in constant attendance.

(4) Requirement that a daily log must be kept of happenings on electrical apparatus in a prescribed log book.

(5) Requirement that defective equipment be put out of service at once.

(6) Special rules covering the use of electrical equipment and wiring in gassy portions of the mine to prevent "open sparking."

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Tests and Requirements for Electric Motors

The users and manufacturers of electrical equipment are taking forward steps to formulate testing procedure for equipment and to meet the expense entailed in having types of equipment tested.

The following regulation approved and issued in 1926 under the auspices of the British Engineering Standards Association (composed of the Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects, Iron and Steel Institute, and Institution of Electrical Engineers) shows the general trend of testing electrical equipment for safety in Great Britain:

British Standard Specifications for Flame-Proof Enclosures and for Testing Such Enclosures

I. Definition of Flame-Proof Inclosure (Including Explosion-Proof) for Electrical Apparatus.

(1) A flame-proof enclosure (including explosions-proof) for electrical apparatus is one which will withstand, without injury, any explosion that may occur in practice within it under the conditions of operation within the rating of the apparatus enclosed by it (and recognized overloads, if any, associated therewith), and will prevent the transmission of flame such as will ignite any inflammable mixture which may be present in the surrounding atmosphere.

Note 1.—In the absence of any statement to the contrary, it is assumed that the flame-proof enclosure has to meet the ordinary requirements of the Coal Mining Industry in which the inflammable mixture to be considered will ordinarily contain methane, but in other industries other inflammable mixtures will be encountered. Similarly it will be necessary to consider other inflammable gases in relation to particular apparatus, such as the gas resulting from decomposed oil in oil-immersed switchgear and hydrogen in storage batteries.

Note 2.— In view of the danger which would result from a destructive short circuit within the enclosure, special attention to details of design and manufacture is necessary. In addition, the protection of the circuit supplying the apparatus should be such as to insure, as far as practicable, that the highest recognized overload for the apparatus shall not be exceeded, having regard to the amount of destructive energy available at the apparatus calculated from the size of generating plant and the impedance of the circuit between it and the apparatus.

II. Specification of Tests for Various Classes of Apparatus to Prove Compliance with the Definition of Flame-Proof Enclosure.

General

(2) In conformity with Note 1 to the Definition of Flame-Proof Enclosure, it is assumed that the apparatus has to meet the ordinary requirements of the Coal Mining Industry in which the inflammable mixture to be considered will ordinarily contain methane.

For some purposes a certificate may be required as to the flame-proof qualities of a casing with respect to such inflammable mixtures as, for example, hydrogen and air. Such a certificate shall be granted only on the results of tests carried out with the particular inflammable gas specified therein.

The design and construction of flame-proof apparatus submitted for test and certificate should comply, as regards flame-proof enclosure, with the B. E. S. A. Specification, if any exists, for such apparatus, but if there is no such Specification then the principles of design and construction, as regards flame-proof enclosure, in any appropriate B. E. S. A. Specification should be observed.

Tests

(3) The following tests shall be carried out with the apparatus correctly assembled, with all its parts (including oil, filling compounds, etc., if any) in place, and with all electrical connections from the interior to the exterior of the casing made. Apparatus designed for the protection of rapidly revolving parts, such as a motor casing, shall be tested with such parts running at their maximum working speed.

To meet the ordinary requirements of the coal mining industry, the casing shall be filled at the air temperature and pressure prevailing at the testing station with the most explosive mixture of methane and air (i. e., containing between 9.5 and 10.5 percent of methane by volume) and shall be surrounded by the most readily ignited mixture of methane and air (i. e., containing between 8.5 and 10.5 percent of methane by volume) at the air temperature and pressure prevailing at the testing station. The tests of flame-proof enclosures in any other inflammable atmosphere than that containing fire damp shall be made with the most explosive mixture of the particular inflammable gas and air at the temperature and pressure prevailing at the testing station. The explosive mixture within the casing shall be ignited, if possible, by the spark produced when an electric current of sufficient intensity is established or broken by the normal mechanical operation of the apparatus. Otherwise, any suitable means may be employed provided that the position of the point of ignition would be produced in the normal working of the apparatus.

It is recognized that until such time as experimental work on the testing of switchgear under short circuit conditions has been completed, it would be unwise to specify that the enclosure should be tested for its flame-proof properties with the apparatus operating under the most severe conditions likely to be met in normal service. The tests specified, therefore, are liable to revision and modification after further research if it is found that testing under short-circuit conditions is essential.

Note.—It is not considered desirable to define the number of tests or the character of any additional tests which the testing officer might desire to make. It is hoped that further instructions can be given after experience has been gained.

Test Certificate

(4) An apparatus that satisfies the requirements of this Specification and has passed the tests to which it has been submitted can be considered as complying with the British Standard definition of Flame-Proof Enclosure and a certificate in the form given in Clause 5 should be granted.

Form of Test Certificate

(5) The following form of test certificate should be used:

Certificate of Test as to Flame-Proof Enclosure.— This is to certify that a ..... (description of article), identical in all essential respects as to design, workmanship and material with that indicated on Drawing No....., has been submitted by ..... (name of maker), for test to prove compliance with the definition of flame-proof enclosure (B. E. S. A. Publication No. 229—1926) and has been found to satisfy the requirements in all respects.

A full report of the tests carried out has been furnished to the maker.

Signed .....
(testing authority)

Date .....

Type Tests

(6) It is not intended, nor is it recommended, that the tests referred to above shall be made on every piece of apparatus supplied.

Unless otherwise specified, when inviting tenders, the purchaser shall accept, as evidence of compliance of the apparatus with this specification, type tests on apparatus identical in all essential details with the one purchased.

Certificates and full report of all type tests with certified detailed drawings of the type apparatus shall be held available by the maker, together with a record of any alterations, whether essential or not, which have been made to the apparatus since any type test was carried out.

Type tests shall be made by a recognized authority.

Twenty-five Government Departments and Scientific and Industrial Organizations were officially represented upon the Committees entrusted with the preparation of the Specification.

Testing of Flame-Proof Equipment

Although the Mines Department tests flame safety lamps, electric lamps, signals, telephones, and shot-firing equipment, it does not test electric motors and their accessories. Such tests as are made are either conducted by the manufacturers of the equipment or are arranged for by them.

The University of Sheffield has an agreement with the manufacturers whereby tests are made of flame-proof equipment at Sheffield. These tests, although generally witnessed by an engineer from the Mines Department, can not be said to be officially endorsed by that department. Equipment that satisfies the conditions laid down for the tests is given a certificate by the university.

The writer witnessed some of the testing work at Sheffield and was deeply interested in it because similar testing work was being done at the Pittsburgh Experiment Station of the U. S. Bureau of Mines.

The test procedure at Sheffield is as follows:

The submittor of the equipment is required to furnish blueprint copies of drawings showing the general construction of the apparatus submitted. These prints are consulted in deciding whether or not the construction of the apparatus is satisfactory and are further used in checking the dimensions of the various parts making up the equipment. Prints are held on file as a part of the permanent record of the test.

The tests are made in a wooden gallery. The gas used for the explosive mixture is methane, which is obtained from a mine and kept in cylinders. An explosive mixture is kept ready mixed in a large container for certain of the tests. In the case of a motor the first test is made by filling the motor with an explosive mixture of methane and igniting the mixture. During this test one end of the gallery is open. This test is made without an explosive mixture surrounding the motor and is for the purpose of observing whether flames come through any of the flanges or the other joints. After the completion of this test, the front of the gallery is put in place and five additional tests are made with the motor surrounded with an explosive mixture of methane and air. Two of the tests are with the motor at rest and three tests with the motor running. Owing to the construction of the gallery, the motor is not under observation in any of the tests in which the motor is surrounded by the explosive mixture. The evidence of safety is, therefore, based upon the one test made at the beginning under observation and the fact that in the additional five tests the gas was not exploded or the compartment blown apart. Pressure records and analyses of gas samples are obtained for all the explosion tests. The proper proportion of the mixture surrounding the motor is judged by exploding samples drawn from the gallery during the mixing of the methane and air. The methane is slowly admitted from one of the tanks and mixed with a fan as it enters.

The gallery is provided with a partition to conserve the amount of gas necessary for producing an explosive mixture. If the apparatus is small enough it is installed in a half section of the gallery.

A typical certificate follows:

University of Sheffield.
Mining Department,
University of Sheffield,
(Seal.) St. George's Square,
Sheffield,
October 15th, 1923.

Certificate No. 40.

This is to certify that a typical example of *Messrs. The Electro-Mechanical Brake Company, Limited, Mining Type Flame-Proof Controller, Type* 50*A.*, 30 *FP.*, has been treated as follows:

> The casing of the controller was filled with the most explosive mixture of fire damp and air, and this mixture was ignited by a secondary discharge from an induction coil, whilst the apparatus assembled as for use was surrounded by a similar explosive mixture.

Under these conditions of test, flame did not pass from the apparatus to the explosive atmosphere outside, which remained unignited, nor did the apparatus suffer damage due to the pressure developed within it.

(Signed) D. HAY,
Professor of Mining.

When one considers the rigid regulations covering electrical equipment in British mines, it would be natural to think that the protective requirements for gassy parts of a mine would be especially severe, but this is not necessarily the case. Much of the equipment used at the face workings has not been tested at Sheffield. The tendency apparently is to place more emphasis on inspection than on actual tests in gaseous mixtures. The Bureau of Mines has found in testing a great many outfits representing the product of several manufacturers that tests are very valuable in showing unsuspected weaknesses of equipment which might easily be overlooked or not evident from an inspection.

Research Work by the Safety in Mines Research Board

During a period of several years a systematic study has been made by the Safety in Mines Research Board, under R. V. Wheeler, of fundamentals that may have a direct or indirect bearing on the design of permissible electrical accessories for motor-operated outfits; the following reports have been issued:

(1) Flame-Proof Electrical Apparatus for use in Coal Mines, by I. C. E. Statham and R. V. Wheeler; Paper No. 5, First Report, Flange Protection, 1924.

(2) Flame-Proof Electrical Apparatus for use in Coal Mines, by C. S. W. Grice and R. V. Wheeler; Paper No. 21, Second Report, Perforated Protection, 1926.

(3) Flame-Proof Electrical Apparatus for Use in Coal Mines, by H. Rainsford and R. V. Wheeler; Paper No. 35, Third Report, Ring-Relief Protection, 1927.

(4) The Pressures Produced on Blowing Electric Fuses, by G. Allsop and R. V. Wheeler; Paper No. 38, 1927.

The writer saw most of the equipment used in conducting these researches and conferred with several of the investigators who had been connected with the work. It may be mentioned here that these researches cover work for which the United States Bureau of Mines has never had sufficient personnel, and as the work has been done in a thorough manner it will probably never be necessary for the bureau to undertake it.

Electrical Inspection

The electrical inspection work in Great Britain is in the hands of the divisional, assistant, and junior mine inspectors; in case of an electrical accident or a difficult electrical problem, these men call on the chief electrical inspector, who has his headquarters at the main office of the Mines Department.

The inspection of electrical equipment is made comparatively easy by the rigid rules (samples of which have already been given) governing the installation of new equipments and the maintenance requirements for all electrical equipment. There is only one electrical inspector, and as his is a huge task it is impossible to avoid some mistakes and misjudgments in permitting installations. Greater safety would undoubtedly result if more electrical equipment was subjected to actual tests in gas.

In addition to the government inspection, many of the owners carry out very complete and systematic periodic inspections. One company with four collieries had a force of 16 electricians and a most elaborate inspection system.

Electrical Equipments in Great Britain and the United States Contrasted

There are a number of differences between the electrical installations in Great Britain and the United States. For instance, in British coal mines there are no trolley locomotives, whereas statistics compiled for 1924 give 11,986 in the United States. Every piece of apparatus and practically every conductor in British mines is earthed by carrying a ground conductor to a ground plate on the surface; practically no earthing is resorted to in American mines except to connect the frames of stationary motors to a pipe or rail return within the mine. Alternating current is not used extensively in American mines, but in British mines this prevails, and direct-current circuits are being replaced by alternating-current circuits in a number of mines. The natural conditions in British mines as to grades, faults, thinness of seams, extreme depth of shafts,

and the difficulty of properly supporting the overburden render the installation of electrical equipment much more difficult than in American mines.

In regard to electrical safety, it can be said without danger of contradiction that the regulations governing the installation, inspection, and maintenance of electrical equipment are better in Great Britain than in America. In regard to the practice of using strictly safe equipment in gassy sections of mines, there is much yet to be done in both countries.

Cooperation between the United States Bureau of Mines and the Safety in Mines Research Board of Great Britain, continuous since 1924, has made possible this and other papers on safety subjects. Grateful acknowledgment is made to representatives of the Safety in Mines Research Board of the Mines Department for their assistance in arranging visits to several mine safety stations, and to F. H. Wynne, Deputy Chief Inspector of Mines, Great Britain, for arranging visits to mines in Great Britain, Belgium, France, and Germany.

NATIONAL COMMITTEE on MECHANIZED MINING

(*From page* 822)

less degree all the other mining operations from the cutting at the face to the preparation at the tipple; it is, therefore, expected that through the general chairmen the work of this committee will cover all changes from hand loading practices which have been developed for mechanized loading in the equipment and mining methods used in these other operations.

"In forming this committee one of the main considerations has been to organize the work in such a way that no great amount of time will be required by any of its members. Each district is limited in extent so that the district representative will probably be able to furnish most of his reports from his own knowledge of local developments. The state chairmen will act as director for the district members and will forward their reports to the Washington office, where the detail and routine work will be taken care of. The general chairmen will receive from Washington the information pertaining to their subjects, and from this they will make an analysis to show the tendency of the development in their particular operation which has been brought about by mechanized mining.

"The reports by the mechanization engineer will continue to be made and published monthly and through the closer contact as provided by this national committee these reports will be able to cover the most important and outstanding operations in each mining field. Periodical bulletins showing the progress made in the various coal fields and the developments in the various phases of mining will be issued from the Washington office to the members of the committee and members of The American Mining Congress. In such publications it will be understood that nothing regarding any coal operation will be made public without the consent of the mining company."

In addition to the major committees on operating phases, The Mining Congress announces the creation of a national publicity committee to cooperate with the main committee to provide ways and means for making the information immediately available to the coal producer and to keep the public informed as to what the industry is doing in solving its problems.

The committee will be responsible also for a Yearbook on Mechanized Mining, which will be the national textbook upon the subject. It will cover all phases of mining in their relation to mechanization, and will be issued each year at about the time of the Annual Convention of Practical Coal Operating Men, held under the auspices of The American Mining Congress, usually in May.

It is believed that the adoption of machine methods as will be developed by this study, which has been outlined to cover a period of five years, will result in great benefits to the coal mining industry. For the public it will mean cleaner and more economical coal; for the miner, safer working conditions through better supervised, better ventilated, concentrated working places. It further offers to the miner an opportunity to materially raise his economic status because of the numerous specialized tasks incidental to the mechanical mining of coal. For the operator, it will mean more continuous and more profitable recovery of his coal. For the manufacturer of mining equipment, it offers a great opportunity to serve the industry and assist it in arriving at that efficiency and prosperity for which it is striving.

The American Mining Congress will announce by December 1, if possible, the personnel of the committee in respect to District Observers, and will make frequent announcement concerning the work as the committee begins to function. All of these announcements, together with the reports of the committees, and the continued personalized investigation by Mr. G. B. Southward, will appear in each issue of THE MINING CONGRESS JOURNAL.

ENGINEERING and MINE FANS

(*From page* 834)

minimized as outlined in this paper by careful calculation, careful test, and judgment.

This study helps to permit proper selection of a fan for specific conditions. What must be the procedure to allow for the undoubted changes in the mine and their effect on the fan performance? This can be answered briefly. A broad range at high efficiency is most desirable. The fan should tend to maintain nearly constant volume with slight pressure changes without change in speed. Thus if a fall in the mine or obstructions in the passageways make a higher water gauge imperative, the fan should automatically respond by producing more pressure without a great falling off in volume.

We can now summarize a few suggestions for due consideration when applying a fan to a mine.

(1) Fix volume requirements as accurately as possible—describing in some detail how these requirements were determined and how the volume is to be measured. Sectioning of airways and use of calibrated anemometers are desirable. Air readings should be taken fairly close to the fan at a point where leakage may be eliminated from consideration or reasonably estimated. Air readings should be taken where turbulence is not a serious factor.

(2) Fix pressure requirements by calculations or accurate test describing conditions at time of test. Normal temperature, barometer and humidity of air entering the fan should be specified.

(3) Outline probable trend of mine pressure volume requirements, giving maximum and minimum probable pressures to permit the required volume to pass.

(4) Obtain characteristic curves of fans proposed. These curves should be based on accurate scientific tests.

(5) Add probable pressure volume curves so as to fix operating range of the fan.

(6) Choose the fan that represents the best all around investment.

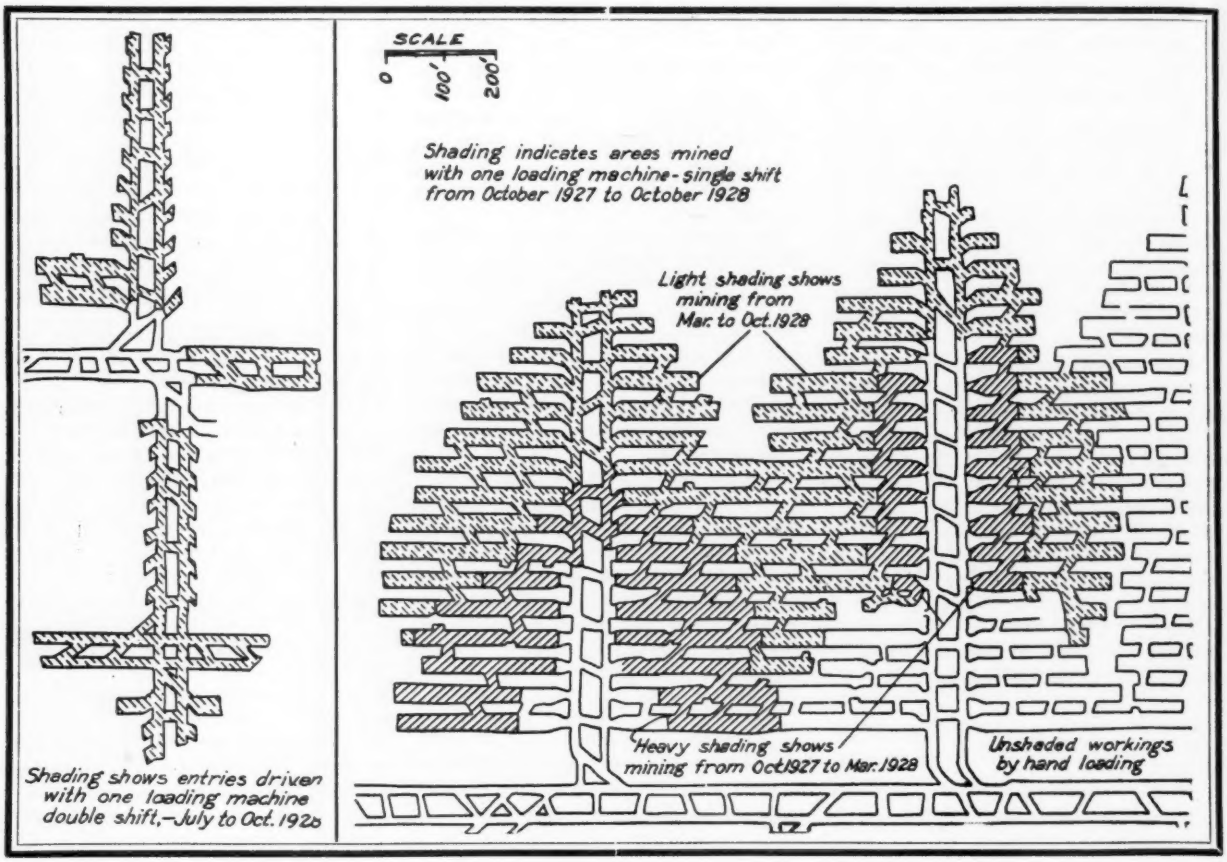
(7) Make frequent checks of the pressure volume relation of the mine, after making sure that sufficient air is reaching the working faces. This will indicate whether or not the airways are needlessly obstructed.

(8) Check horsepower and probable efficiency of the fan frequently. Power to drive a fan is a direct expense. A misapplied fan on a mine with obstructed airways can easily waste $10,000 a year.

(9) Investigate the desirability of providing some means to adjust the fan r. p. m. either by changes in motor speed or by pulley or gear changes.

In order that the proper procedure may be clear, a practical problem is given.

Calculations or careful tests indicate that a certain mine requires 200,000 c. f. m. at minimum water gauge of 1½-in. static pressure when measured at the fan and when corrected to normal air standards. (*Continued on page* 848)



MECHANIZATION REPORT NO. 87

By G. B. SOUTHWARD

THIS report describes a room and pillar mining operation with mechanical loaders in a seam of coal which varies from 6½ to 7 ft. in height. The mine was operated with hand loading for a number of years until November, 1927, when mechanical loaders were installed and all hand mining was discontinued. Five mechanical loaders are now in operation, four are working in rooms and one is in entry development; three pit car loaders are used for entry advancement, and the total production with the amount of equipment is now averaging about 1,650 tons per day. Some work has been done with conveyors in rooms, but this has been largely experimental.

At this mine the management realized that the success of mechanized operation depended to a very great extent on the attitude of the men in charge underground. Accordingly, before any machines were installed, the underground foremen were sent to visit and study some mechanized operations and the management selected those who evidenced a firm belief not only in the future possibilities for mechanized mining but who also believed that the immediate adaptation of these methods would show

MECHANICAL LOADERS IN ROOMS AND ENTRY DEVELOPMENT

economies over their hand mining which was then going on. As a result of this, the men who were put in charge were optimistic and sufficiently interested to overcome such difficulties as were met and the mechanized mining has been on a satisfactory operating basis from the time that the first machines were installed.

The map which is submitted with this report shows the workings that were mined with one loading machine on single shift from October, 1927, to October, 1928. The mining during the two six-month periods of this year is indicated by two methods of shading. This map also shows the amount of entry development that was driven by one loading machine on double shift during the three months from July to October, 1928. In both these panels the time required to work the areas shown was from one-half to one-third of the time that would have been required with hand loading.

The mining system used and the panel dimensions, width of entries, rooms and pillars is about the same as was used in hand loading. However, there have been a number of changes from hand mining practices that have been developed for mechanized loading; a new track arrangement for the rooms and the method of timbering at the room faces represent distinct departures from preceding practice and illustrate the more systematic methods which have been designed and applied underground.

The track arrangement for the rooms is illustrated in figure 2, which shows the method of starting the rooms and the subsequent layout after the first breakthrough has been passed. The extra track work required to keep the switches moved forward is more than repaid by the time saved for the gathering locomotive serving the loading machines. An indirect advantage also results from the fact that no track or timbering maintenance is required in the rooms between the neck and the last breakthrough.

The method of setting and moving timbers at the face of a room is illustrated in figure 3.

OPERATING REPORT

Physical Conditions

The seam has an average height of from 6½ to 7 ft. of medium hard structure coal, with a slate parting varying from ½ to 2 in. thick, about 1½ ft. above the bottom. The top is variable and some bad areas are encountered, but usually the roof stands well in the rooms without excessive timbering. The bottom is a hard fire clay. The seam is generally level and has between 500 to 600 ft. of cover. Open lights are used and the entries are sprinkled.

Mining System

The mine is worked on the advancing room and pillar system. Pit car loaders are used in some instances to develop the main entries, but the regular practice in a standard panel is to drive the entries and advance the rooms with mechanical loaders. No pillars are at present being recovered. The entries are driven 12 ft. wide on 42-ft. centers; the rooms are 28 ft. wide on 50-ft. centers, driven 325 ft. long. A panel has 38 rooms—19 to the right and left of each side of the entry and 8 rooms are usually kept under development on each side with the entries advancing at a sufficient rate to keep this number of working places constant.

One loading machine is used in a panel and works the rooms off both sides of the entries. The loading is done on the day shift and the cutting is usually done at night, and both these operations alternate from one side of the entry to the other. The working places under development in the panel are sufficient for two loading machine operations, particularly since the cutting and shooting is done on the night shift, but for the present the management has preferred to operate only one machine in a panel in order to have constant supervision.

Cutting and Snubbing

The coal is machine undercut with an 8½-ft. bar and is drilled with an electric drill. Two methods of shooting are used. One is with permissible explosives and the other is with carbon dioxide cartridges. In both cases, three snubbing shots are made directly above the slate parting, which is about 1½ ft. above the bottom of the seam. This coal is then pulled out by hand and the slate is thrown back in the gob. The space thus made permits fairly light shooting in the top coal and produces a large percentage of lumps. Four top shots are fired.

A crew of six men is used on the face preparatory work for each loading machine operation—two on the cutting machine, one to load out the bug dust into mine cars, one driller and two hand snubbers. This work is usually done on the night shift.

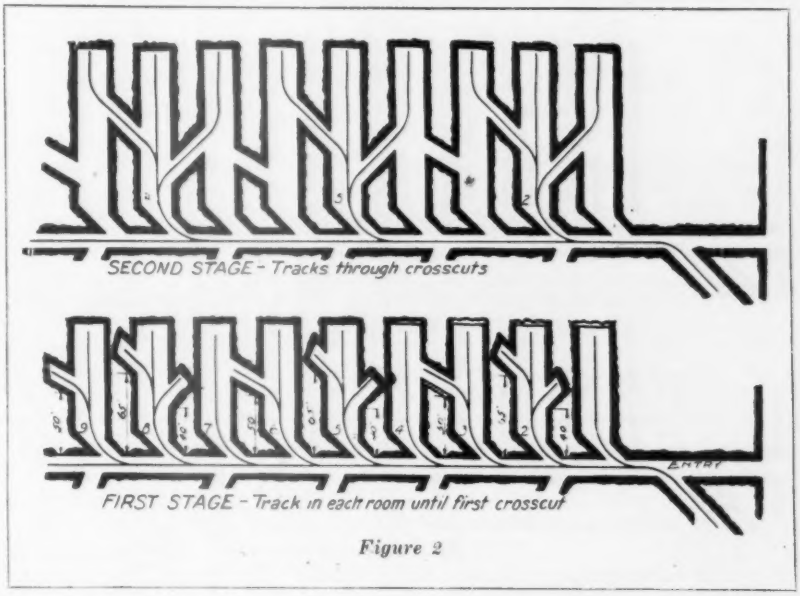


Figure 2

Mechanical Loading

The loader works and travels on caterpillar tracks and discharges into mine cars which are placed by a gathering locomotive. Two men operate the machine, one at the control and one at the head end.

Two hand clean-up men follow the machine to load out the loose coal in the corners of the room, scrap the bottom and pick down any hanging coal from the face and roof. It has been found economical at this operation to use these two clean-up men in order to eliminate the time lost by the machine operation in cleaning up the small quantity of coal left in the corners of the room.

Hauling

A gathering locomotive with a crew of two men serves each loading machine and shifts out single cars as loaded to the track in one of the adjoining rooms. The mine cars average two and six-tenths tons capacity.

A single track is laid in each room using 30-lb. steel on 42-in. gauge according to the arrangement as shown in figure 2. Every fourth room serves as the haulage way to the panel entry for the two adjoining rooms on each side, and as the rooms advance the connecting switches through the cross-cuts are moved ahead into the last breakthrough near the working face. A crew of three men extend the track and switches for one loading machine operation.

Timbering

The top generally stands well in the room, but there are a sufficient number of bad top areas encountered to make it necessary to timber all rooms carefully. Four permanent timbers are set after each cut has been cleaned up, but the track arrangement already discussed eliminates the necessity for holding the top back of the last room breakthrough. One timberman is employed with each loading operation; no pillars are drawn and no timbers are recovered.

Summary of Regular Crew Employed for Each Loading Machine Operation

Machine operators	2
Hand clean-up men	2
Cutting-machine men	2
Snubbers	2
Driller	1
Bug-dust loader	1
Gathering locomotive crew	2
Trackmen	2
Timberman	1
Total men, including both day and night shifts	15

Equipment

Each loading machine operation uses one cutting machine, one electric drill and one gathering locomotive.

Production Record

An average of from five to six rooms is loaded out during each shift with the loading machine, each room producing from 45 to 50 tons. With pit car loaders, an average of three entries is loaded each shift, each entry producing about 20 tons.

Preparation

With the snubbing methods used, the sizes of the coal with mechanical loading are practically the same as in hand mining, and by removing the slate at the working face no extra picking is required on the tipple.

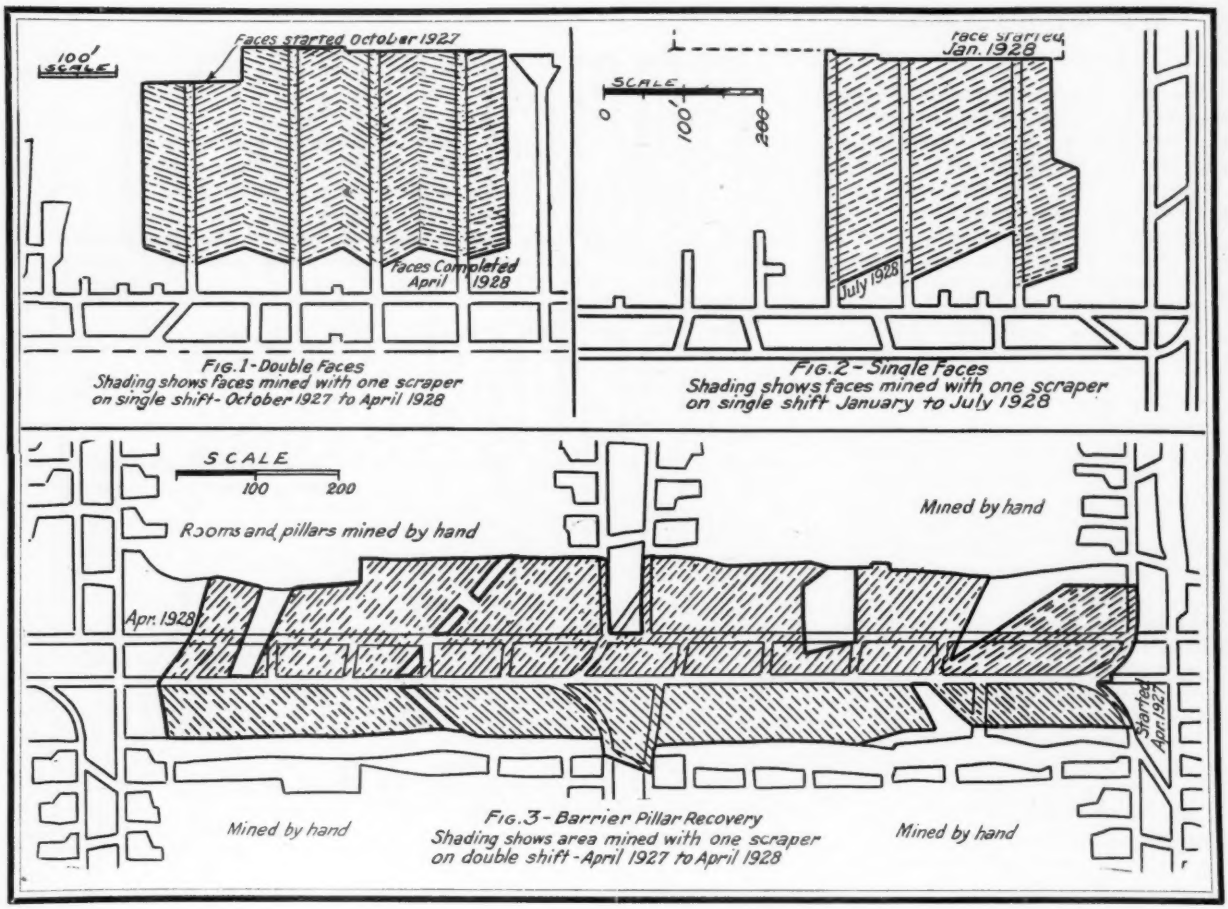


FIG. 1 - Double Faces
Shading shows faces mined with one scraper on single shift - October 1927 to April 1928

FIG. 2 - Single Faces
Shading shows faces mined with one scraper on single shift January to July 1928

FIG. 3 - Barrier Pillar Recovery
Shading shows area mined with one scraper on double shift - April 1927 to April 1928

MECHANIZATION REPORT NO. 88

By G. B. SOUTHWARD

SCRAPER MINING ON LONG FACES IN V SYSTEM

REPORT Number 88 describes an operation with scrapers on modified long face mining in a seam of coal about 3½ ft. high. The mines of this company have been worked for a number of years with hand loading into mine cars until the early part of 1927, when a scraper installation was made. This proved successful and by the end of 1927 twelve units had been installed. In 1928 fifteen more units have been added and there are now 27 scraper operations at five mines of this company. Some experimental work has been done with the scrapers in developing entries but at the present time only two units are used for this purpose while the remaining 25 are on long face mining in panels where the entries have been driven with hand loading.

During the year from April, 1927, to April, 1928, a total of 155,994 tons were loaded by scrapers. In the five months from April, 1928, to September, 1928, a total of 80,188 tons were mined—a monthly production of approximately 16,000 tons. During both these periods new installations were being added and the entire operation was not running at full time, so that the average production per day for each unit based on these tonnages does not represent the actual full-time capacity. The present daily production for an installation depends on the length of face mined; this varies from one 75-ft. face which produces about 60 tons, to a pair of faces producing about 125 tons.

The maps submitted with this report show some typical operations. These are all working in what is known as the "V" system in which either one or two faces are turned off of a single entry but instead of being at right angles to the entry the faces are angled in so as to form a "V." Entries are driven by hand and the faces worked retreating with scrapers to mine the solid pillar between the entries. The coal is dragged by the scraper from the face down through the entry to a side track on the haulway, where a trip of mine cars is placed for loading.

Figure 1 shows a panel in which the single entries were driven on approximately 100-ft. centers and the pillars were mined by pairs of faces turned off the single entries. This panel is 250 ft. wide by 450 ft. long and this area was mined by one scraper operation in a five and a half month period—from October, 1927, to April, 1928.

Figure 2 shows a section of a panel in which single faces were worked off the entries. This area is 250 ft. wide by approximately 300 ft. long and was mined by one scraper operation in six months—from January to July, 1928.

Figure 3 shows a recovery of a main barrier pillar located between two areas which had been worked out several years ago with hand loading. This pillar was mined by two retreating faces turned off of the main entry, the total length of the two faces being about 220 ft. The faces were worked on double shift and

the sketch shows that a pillar approximately 200 ft. wide was mined out for a distance of 1,200 ft. in one year's time—from April, 1927, to April, 1928. The map also shows what blocks and stumps of coal were lost and it will be noticed that while the recovery has not been 100 percent, a high rate of extraction was made. The rate of mining and the percent of pillar recovery makes an interesting comparison with what would ordinarily have been expected on work of this nature by hand loading.

In these scraper operations several advantages over hand mining have been found. The scraper eliminates hand shovelling and results directly in an increased tonnage per man employed for loading at the working faces. Since mine cars are not taken to the working faces, there is no necessity for brushing top in the rooms and this has further resulted in the adoption of a much larger capacity mine car than was practicable to use in hand loading. Another advantage is had by placing trips of cars at the scraper loading point, which eliminates gathering haulage entirely. The cost savings which have resulted directly and indirectly from the abovementioned items are reported by the management as being a very material reduction under the cost of mining by hand. This is evidenced by the fact that this coal company has made 27 scraper installations in the last year and a half.

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OPERATING REPORT

Physical Conditions

The seam has a height of about 40 in. of medium hard structure coal. There are no regular bands of slate but intermittent streaks of impurities occur. The top is a hard slate which can be supported on timbers over fairly large areas and breaks without crushing the coal when caved. The bottom is a hard fire clay. The seam is level with local rolls. The cover varies from outcrop to 400 ft. Open lights are used.

Mining System

The mining system is a modified long face retreating method known as the "V" system, with scraper loading on the faces and the entries driven by hand. Panels about 300 ft. wide are developed by a pair of entries off of which single entries are driven at right angles 300 ft. through to the panel limit. The single entries are usually spaced from 75 to 100 ft. apart and the narrow work develops the panel into rectangular blocks of coal about 75 ft. wide and 300 ft. long. These blocks are recovered by long faces which start at the panel barrier and work retreating down to the entry stump which is left to protect the haulage way. In some cases, two faces are worked off of each single entry, turned to the right

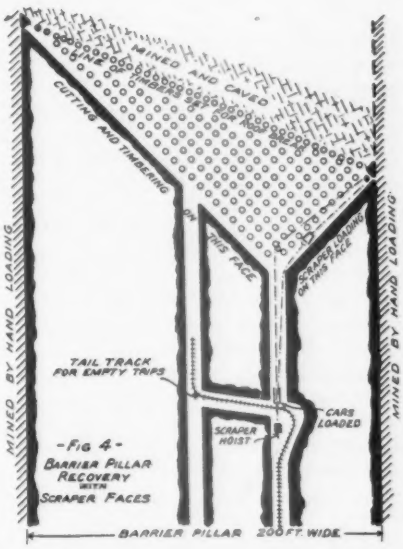

Fig 4—Barrier Pillar Recovery with Scraper Faces

and left and in other cases a single face is worked off one side. Only one scraper is operated at one time in a panel.

The coal on the faces is loaded with a scraper which is dragged along the face and down through the single entry to the haulageway, where the coal is discharged into a trip of mine cars. The scraper is operated by a double drum electric rope hoist set opposite the mouth of the single entry. Figure 4 shows the general arrangement for barrier pillar recovery.

Face Loading

A crew of two men is used along the face for loading, to guide the scraper, pick down any hanging coal and to scrap the bottom. At the loading point two men are employed, one to operate the scraper hoist and one to trim the cars and operate a small hoist which moves the cars in a solid trip. This makes a total of four men for the loading crew.

The panel shown for figure 1 was worked by two faces off a single entry, each face being approximately 75 ft. long. In this operation two faces were usually loaded out during a day shift. In the barrier pillar recovery shown in figure 3 the total length of both faces was about 220 ft. In this operation the two faces were usually cleaned up in a day and a night shift. In both these operations all work was performed continuously during the working shift, loading on one face while the cutting, timbering, and other preparatory work was being done on the other.

Cutting and Blasting

The coal is undercut to a depth of 6 ft., drilled with an electric hand drill and fired with permissible explosives. A crew of two men do the cutting and drilling for one scraper operation, and this work is usually done on the same shift as the loading.

Hauling

Mine cars of approximately 3-ton capacity are delivered in trips of 12 cars by a gathering locomotive and a small rope hoist is set at each loading point to move the cars in a solid trip past the scraper discharge. The cars are a new steel type which have been installed at this mine for scraper loading and are at least double the capacity of the old type cars used for hand loading. The track along the haulway is laid with 30-lb. steel on 42-in. gauge.

Timbering

The top in the "V"-shaped area between the faces is supported on timber posts which are set about 6 ft. apart in rows parallel to the faces. One row is set after each cut about 8 ft. from the face of the coal before it is shot down. This provides a scraper way free of timbering.

As the mining progresses the top is caved periodically, usually after an advance of about 60 ft. has been made. When a fall is about to occur a double row of timbers is set across the "V" from the end of one face to the end of the other and the roof generally breaks on this line leaving the face open. About 60 percent of the timbers are recovered, and the management reports that the timbering costs on their scraper faces have been less than the timbering costs in their room and pillar mining with hand loading.

Operating Crew

Hoist operator	1
Car trimmer	1
Face loaders	2
Timberman	1
Cutters and drillers	2
Total men	7

In addition to these there is a gathering locomotive crew of two men, but one locomotive will serve several scraper operations. After a block is mined out some extra work is required to move the hoist to a new location. This ordinarily occurs about once a month and the new set-up is made by the regular scraper crew in one working shift.

Equipment

Each operation uses one scraper complete with hoist, rope and loading ramps, one cutting machine, one electric hand drill, and one electric rope hoist for moving the car trips.

Preparation

The management reports that the coal from the scraper faces has as high, and probably a higher, percentage of lump than is had in hand mining. Some slate is picked along the face, but more picking labor is required on the tipple than is necessary with hand loading.

MINE DRAINAGE in WESTERN PENNSYLVANIA
(*From page* 839)

from $7.50 to $15 per ton. This plant has not been operating for three years, and at present there is no market for the recovered material. A thickener of such capacity costs about $11,500 erected, allowing a fair amount for the concrete pit construction.

The cost of limestone, obtained locally and ground at the plant for neutralizing, was said to be about $1.25 per ton; daily costs of this material varied between $1.37 and $1.64 per day. Since half or more of the weight of limestone is usually inert material, the cost of available calcium oxide may be about $2.50 per ton.

Worked-Out Mines that Still Yield Acid Water Might Be Sealed Up

There is little doubt that, with the exception of some of the larger companies with ample finances or of others whose mines have only slightly acid or alkaline waters that are easily treated or are unnecessary to treat, individual installations of the type just described would prove such a financial burden as to force a great many mines to cease production, unless the additional cost could in some way be distributed over the coal industry as a whole. The solution of the problem of drainage disposal after coal areas have been mined out and acid water still continues to flow for an indefinite time is also uncertain. One possible solution is to seal abandoned mines so as to exclude the air and thus prevent further oxidation of the pyrite. It seems likely that water from such mines would become pure again in less time than if they were not sealed.

Considerable improvement in certain sections that are now being polluted by water from abandoned workings might be accomplished by sealing the mines; the cost would not be great and the process does not appear difficult in most cases. The success of this scheme seems very probable because it has repeatedly been shown that where abandoned mines are sealed either by natural caving or by building seals, the water is suitable for all ordinary uses, sometimes even for drinking water.

Economics of Neutralization of Water

The final problem of neutralization of acid mine drainage is one of economics; in that aspect it must be considered separately for specific sections or communities. The factors involved are of such a nature that one hard and fast rule can not be applied with equal satisfaction in all cases. There is little doubt, however, that the neutralization of mine waters can be successfully accomplished so far as chemical and mechanical questions are concerned.

Appendix

Tables 3 to 10, inclusive, referred to under "Sampling," give analyses of samples of water from various workings of the mines examined during 1925 and 1926.

In acknowledgment, the writer wishes to thank Dr. R. R. Sayers, chief surgeon; A. C. Fieldner, chief chemist; and W. P. Yant, supervising chemist, health laboratory section of the Pittsburgh Experiment Station, all of the Bureau of Mines, under whose direction the work was conducted.

ENGINEERING and MINE FANS
(*From page* 843)

From a careful study, the maximum probable water gauge for 200,000 c. f. m. has been found to be 4 in.

The pressure volume parabolas for the extreme conditions may be tabulated as follows and plotted as shown in Figure 1.

Minimum R_1		Maximum R_2	
C.F.M.	Water Gauge	C.F.M.	Water Gauge
25000	.023	25000	.0625
50000	.094	50000	.25
100000	.375	100000	1.00
150000	.844	150000	2.25
200000	1.500	200000	4.00
250000	2.344	250000	6.25
300000	3.375	300000	9.00

These curves are designated as R_1 and R_2 on the diagram.

Capacity and efficiency curves are indicated on the same diagram for a proposed fan running at some normal r. p. m. The intersection of the capacity curve with curve R_1 indicates that this fan at its given speed will deliver 200,000 c. f. m. at 1½ in. static pressure at 67.5 percent static efficiency.

If the resistance is as given by curve R_2 the fan capacity at normal speed falls to 133,000 c. f. m. at which point the efficiency would be 68.5 percent and the water gauge 1.78 in.

In order to force 200,000 c. f. m. through the mine, the fan speed must be increased approximately 50 percent, the efficiency will remain approximately 68.5 percent and the water gauge rises to 4 in.

The conditions assumed are quite extreme unless a considerable time is surveyed. In other words, the problem might readily cover the pressure volume variation for the life of the fan.

The swings in mine resistance for the hourly or daily changes in the mine would be very much less and the variation in volume of air delivered by a proper fan would be so small that the usual constant speed operation would be satisfactory. Of course the speed would require adjustment from time to time as mine resistance increased, as often as the volume fell below some minimum, possibly some such quantity as 180,000 c. f. m.

At the normal r. p. m. when the fan is installed 180,000 c. f. m. can be delivered at 1.6 in. w. g. with an efficiency of 69.4 percent. This corresponds to a water gauge of 1.97 in. for 200,000 c. f. m. or 31 percent greater than the 1½ in. estimated for the mine.

It of course follows that proper study enables the buyer to select a fan that best meets the probable changes in his mine. Such a study justifies a considerable reduction in that large annual fixed charge item—depreciation and obsolescence—and further insures a great saving in power cost.

IMPROVING MILLING PRACTICE IN TRI-STATE ZINC DISTRICT

In the course of a general study of the ball milling of zinc ores of the Missouri-Kansas-Oklahoma district, being conducted at the Mississippi Valley Experiment Station of the Bureau of Mines, Rolla, Mo., a means has been adopted to find the dead load of the mill. When the dead load is subtracted from the total load during grinding, the net power—that is, the power expended within the shell of the ball mill—is the result. To obtain the dead load, a weight equal to the balls, ore and water is packed into a central position in the mill so that it revolves like a fly-wheel, and the required power thus determined.

Having obtained a measure of the energy expended within the shell of the mill during working conditions, the way is clear for a scientific study of the mechanics of ball milling. Five mills ranging in diameter from 18 to 42 inches are available; they are of the tire-and-trunnion type. In commercial work the advantage gained by increasing the diameters of the mills is often under discussion. Comparative laboratory runs show that the net power varies as some function lying between the square and cube of the diameters. Refinements are being added for more precise determination of this ratio.

One mill has been arranged so that the balls may be seen in operation when working alone. To do this the solid endplates of the mill are replaced by coarse-mesh screens. The circular paths and trajectory paths may be observed. Examination makes it obvious that the balls in the inner circular path do but little work. The critical speed when the balls cling to the circular path by centrifugal force may be definitely determined. Many other coordinates may be located. The arrangement will permit the taking of moving pictures.

METAL MINING FATALITIES DECREASE

The Bureau of Mines reports that the metal-mining industry in the United States had fewer deaths and injuries from accidents in 1927 than in 1926. The death rate was reduced from 3.47 per thousand employes (300-day employes) to 3.10 per thousand and the nonfatal injury rate was reduced from 245 to 222 per thousand employes.

The death rate for copper mines was substantially the same as in the previous year but the injury rate was reduced 9 percent. The iron-mining industry effected a reduction of 14 percent in the injury rate and 42 percent in the death rate. The large reduction in the death rate was mainly due to the fact that the rate for the previous year was abnormally high on account of a single disaster in which 51 lives were lost. Lead and zinc mines in the Mississippi Valley States lowered their fatality rate 13 percent and the injury rate more than 2 percent. A reduction of 7 percent in the injury rate was shown for mines producing gold, silver and miscellaneous metals, but the death rate for this class of mines was 20 percent higher than in 1926. Mines producing nonmetallic minerals showed a reduction of 16 percent in the fatality rate and 10 percent in the injury rate.

The metal mining industry in 1927 employed 110,669 men who worked 34,033,963 shifts, an average of 284 shifts per man. The number killed was 352 and the number injured was 25,133. In 1926, 127,823 men worked 37,160,978 shifts and there were 430 deaths and 30,350 nonfatal injuries.

Last year 73,185 miners worked underground, 15,933 in open pits and 30,581 at surface shops and yards. The number of shifts worked underground was 21,392,033; in the pits, 4,056,705; and 8,585,225 on the surface. Compared with 1926 the number of open pit men shows a slight increase but that for underground men and for surface employes was somewhat less in 1927. The average number of days worked per man was 292 for underground operations, 255 for open pit mines and 281 for surface work. The number of fatal accidents underground was 290 as compared with 350 in 1926, the latter figure including 51 deaths in a single disaster in an iron mine in Michigan. Open pit mines reported 28 men killed as against 33 in the previous years; deaths occurring among surface workers numbered 34 as compared with 47 in 1926. The number of nonfatal injuries underground was 20,448; open pit, 1,603; surface, 3,082. Fatality rates per thousand 300-day workers were 4.07 for underground workers; 2.07 for men in open pits, and 1.19 for surface employes. Corresponding nonfatal injury rates were 287, 119 and 108 per thousand men employed.

Copper mines employed 30,724 men who worked 9,625,317 shifts. Of these 111 were killed and 8,379 injured. In the gold, silver, and miscellaneous metal mines 114 were killed and 8,162 injured out of 30,461 men who performed 8,752,024 days of labor. Iron mines reported 33,386 men and 8,921,001 shifts, 73 killed and 3,409 injured. Lead and zinc mines (including fluorspar mines in Illinois and Kentucky) had 12,499 men, 3,176,606 shifts, 28 killed and 3,152 injured. The nonmetallic mineral mines employed 12,629 men who worked 3,559,015 shifts; 26 were killed and 2,031 injured. Fewer men were employed in each of these groups in 1926 with the exception of the iron mines where there was an increase in men but a decrease in the number of man shifts.

TREATMENT OF OXIDIZED LEAD ORE CONTAINING MOLYBDENUM

Several mines in the Star district near Milford, Utah, have recently struck bodies of oxidized lead ore containing large quantities of plumbojarosite and some wulfenite. The lead molybdate appears to be uniformly distributed through the ore now being mined, and analyses show a molybdenum content of 4 percent. The iron content of samples brought to the Bureau of Mines was 30 percent, and they contained about 20 percent lead and 9 ounces of silver. Under present conditions this ore is shipped to the smelter and is paid for on the basis of its lead and precious metal content. The molybdenum is slagged off with the iron, and therefore constitutes not only a total loss but also an economic waste.

Ores of a similar type occur in other mines of the Star district and also in other localities, and in some instances they are of too low a grade to be mined and shipped at a profit. Ores of this general type are difficult to treat because of the plumbojarosite content, and are not amenable to gravity or flotation concentration. Such ores usually occur in regions where the water supply is deficient, which further complicates matters.

An experiment conducted on ore from a certain mine indicates that a high recovery of the lead and probably the silver can be obtained by chloride volatilization, which appears peculiarly adapted to this type of ore. The results of treating a sample of this ore for 1½ hours by this method, using 10 percent NaCl and a temperature of 850 degrees C., showed removal of 94 percent of the lead. The calcine showed no tendency toward sintering, and it was thought that its further treatment under conditions similar to those used in producing sponge iron might result in metallization of the iron and molybdenum, thus producing ferromolybdenum.

The calcine was mixed with equal parts of minus 8 mesh coke and treated for 1 hour at 1,000 degrees C. The metallized content from this treatment was removed with a magnet, and analysis showed that it contained 88 percent iron and 11.6 percent molybdenum. Whether there is a market for ferromolybdenum of this grade is not known, but the preliminary test suggests that further investigation should be conducted along similar lines with the aim of developing a method of treatment for oxidized lead ores containing molybdenum.

OIL OUTPUT IN 1927 BROKE ALL RECORDS

Final figures on American petroleum output for 1927 are announced by the Bureau of Mines as 901,129,000 barrels.

This is a new record for all time and far above any previous year's production. The oversupply of petroleum was indicated, the bureau said, by the fact that total stocks of all classes of petroleum were 65,453,000 barrels higher at the end of the year than at the beginning.

One of the principal factors in the increase was the exceptional productivity of the Seminole district in Oklahoma, which was credited with a petroleum output of 136,000,000 barrels in 1927 as compared with 11,000,000 barrels in 1926.

The production of gasoline and other motor fuels from petroleum in 1927 was 334,039 barrels, which was also a new record.

BOOK REVIEW

HOW RADIUM OCCURS IN NATURE—*A Monograph by E. de Hautpick, Adelaide, Australia.*

This work of 15 pages is a very complete treatise on the production of radium, including standards, methods of extraction, world production, uses, price and market.

Aluminum has commonly been considered as the most striking example of complicated mineral manufacture, but the author states that to produce 1 gram (1/31 of an ounce) of radium, 500 tons of carefully sorted ore are required, in refining which 500 tons of various chemicals must be used, then the power of 1,000 tons of coal, 10,000 tons of purified or distilled water, and the labor of 150 men for 1 month.

Four forms of radium-bearing ore discussed, and the future of the world's radium supply is forecasted. The author also compiles existing data on radioactive waters and shows why economic geology prefers uranium to thorium as a source of radium.

Evans-Wallower Stockholders Approve Financing Plan — Work Started on New Zinc Plant

At a meeting of the stockholders of the Evans-Wallower Lead Company, held in Joplin, Mo., October 17, a plan of financing was approved which provides for the disposal of $1,250,000 of preferred stock. The proceeds of this financing will be used for the construction cost and working capital required for the electrolytic zinc plant which the company is building at Monsanto, East St. Louis, Ill. Stockholders will have the right to purchase for each 36 shares of common stock held one unit consisting of one share of 7 percent cumulative preferred stock and four shares of no par common for the price of $102.

Based on the contracts already placed and estimates submitted, it is believed that the plant construction will be well within the engineers' estimates of cost.

The plant probably will be completed and ready for operation in June or July of next year. Sulphur gas from the roasting of the ores will be sold to the Monsanto Chemical Company and power will be purchased from the Union Electric Light and Power Company of St. Louis, the plant of the Evans-Wallower Company being adjacent to the Cahokia power plant of the electric company.

The Evans-Wallower plant will use the same process for the manufacture of zinc that is used in the plant at Kellogg by the Bunker Hill Company. This is known as the Tainton process, and is stated to be the most efficient electrolytic method of the smelting of zinc.

Minnesota Iron Ore Tax Appealed to Supreme Court

The question of whether the land owner or the mining company lessees should pay the 6 percent tax imposed by Minnesota on iron ore royalties is involved in cases appealed to the U. S. Supreme Court from the Minnesota Supreme Court. The Vermilion Mining Company, the Crete Mining Company and the Inland Steel Company have asked that a decision of the Minnesota court, which decided in favor of the land owners who brought the suit in the state court, be set aside. The case involves annual taxes of $1,000,000. The mining companies claim that if the royalty tax is construed as a tax upon land, it violates the Constitution by depriving them of their property without due process of law. Under their leases the companies say they are obligated to pay all taxes on the lands and improvements operated by them but not the taxes on royalty received by the lessors. The land owners claim that while the tax is on royalty received it is a tax upon the land, payable by the lessees. The mining companies deny that the tax on royalty receipts is a tax on land.

Herbert Hoover Awarded the John Fritz Medal

The John Fritz Gold Medal, the highest honor bestowed by the engineering profession of this country, has been awarded for 1929 to Herbert Clark Hoover, it is announced by the Engineering Foundation, 29 West Thirty-ninth Street.

"The choice of Mr. Hoover," according to the announcement by Alfred D. Flinn, Director of the Foundation, "ended a process of selection begun a few years ago.

"The award was tentatively made a year ago by the John Fritz Medal Board, which is composed of 16 recent past presidents of the four national societies of civil, mining and metallurgical, mechanical, and electrical engineers, having together a membership of nearly 60,000.

"By this award, which was unanimous, the board sought to express the high appreciation of Mr. Hoover's professional brethren for his distinguished attainments as an engineer, particularly in mining operations in this and other countries, and his great services as a man to his fellows.

"Notable among his engineering achievements are the successful introduction into other countries of improved American mining methods. His scholarly accomplishments are also worthy of mention, especially his translation into readable English from difficult medieval Latin of Agricola's famous book. 'De Re Metallica.'"

The medal, a memorial to the late John Fritz, of Bethlehem, Pa., long a leader in the American iron and steel industry, will be presented to Mr. Hoover at the annual meeting of the American Institute of Mining and Metallurgical Engineers in the third week of February next in New York

During recent years Mr. Hoover has been made an honorary member for life of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Society of Mechanical Engineers.

This is the twenty-fifth award of the John Fritz Medal. The first was to John Fritz in 1902 in celebration of his eightieth birthday. Among the previous medalists are:

Elmer Ambrose Sperry, for the development of the gyroscope; Edward Dean Adams, for achievement in the development of hydroelectric power at Niagara Falls; John F. Stevens, for achievement in planning and organizing for the construction of the Panama Canal, building of railroads, and admin-

MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON IN 1927

(In terms of recovered or recoverable metal)

Advanced figures by C. N. Gerry of the United States Bureau of Mines, Department of Commerce.

County	No. of producers	Ore treated	* Gold	* Silver	Copper	Lead	Zinc	Total value
		Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Chelan	2	10	20.51	5	53	.....	.....	$434
Ferry	7	36,945	15,083.57	114,863	.....	.....	.....	376,932
King	1	25	37.97	303	.....	1,354	.....	1,042
Kittitas	3	.....	18.82	5	.....	.....	.....	392
Pend Oreille	4	35,348	11.03	2,913	1,075	290,861	986,576	80,285
Pierce	1	47	1.02	113	12,407	.....	.....	1,710
Snohomish	2	37,097	132.98	17,476	1,602,438	.....	.....	222,577
Stevens	12	3,267	7.60	19,552	69,875	662,788	343,134	84,340
Whatcom	1	6,462	4,200.01	220	.....	.....	.....	86,947
Total 1927	33	119,201	19,513.51	155,850	1,685,848	955,003	1,279,710	854,659
Total 1926	58	54,343	9,340.82	171,649	1,351,890	4,546,228	1,044,354	931,491

* Includes placer production.

istration of the Chinese Eastern and Siberian Railway during and immediately after the World War; Ambrose Swasey, as a designer and manufacturer of instruments and machines of precision, a builder of great telescopes, and the founder of the Engineering Foundation; Senator Guglielmo Marconi, for the invention of wireless telephony; Gen. John J. Carty, for achievement in telephone engineering.

Utah Copper Erecting Precipitation Plant

The Utah Copper Company has begun construction of a precipitation plant for the recovery of copper from the waters that find their way down Bingham Canyon. The plant will be located between Bingham Canyon and Copperton.

The entire surface flow of water down Bingham Canyon carries a small amount of copper that has been dissolved as the waters flow over or through parts of the large copper deposits. These waters will pass through the precipitation plant in order that this copper may be recovered. The plant will be in operation shortly after the first of the year.

Acme Mine Completes Plant

The new reduction plant of the Acme Mines and Mill, Inc., in Napa County, Calif., is now completed and will be placed in operation about November 1. The property of the company, known as the La Joya Mine, has been under development for some time, and a substantial tonnage of quicksilver ore has been developed.

The new plant includes a Gould rotary furnace with a capacity of 40 tons per day. It is new throughout and follows the most modern practice in the treatment of quicksilver ores. Tanks are of redwood, and special acid-resisting metal pipes are used. The plant is designed so as to require the minimum of labor and to give a high quicksilver extraction.

Minaret Mines Company Plans Winter Operations

The Minaret Mines Company, which is carrying on a development campaign on the Johnson group in the High Sierras of Madera County, Calif., has completed preparations for continuing its development program throughout the winter. A 12-mile road from the property to an existing road near Mammoth has been completed and supplies for winter operations have been brought in.

Camp buildings, including bunk houses, boarding house, storeroom and office, have been built.

Present development consists of the deepening of a shaft from the 100-ft. to the 400-ft. level.

TRI-STATE ZINC & LEAD ORE PRODUCERS' ASSOCIATION TO BE CONTINUED

Operators who produced approximately 205,000 tons of zinc concentrates in the first six months of this year, or about 70 percent of the total output of the Tri-State District, have signed up for membership in the Tri-State Zinc & Lead Ore Producers' Association, it was announced at an open meeting attended by more than 60 mining and business men of the district, held at the Picher, Okla., offices of the association October 11. As this is almost double the tonnage represented in the past year, it assures the continued operation of the organization. The five-year period for which the association was formed expired on October 1.

Companies who have applied for membership include the American, Barnsdall, Beck, Bilharz, Black Eagle, Childress, Commerce, Consolidated, Cortez-King Brand, Vinegar Hill, Smith-Davis, Century, Eagle-Picher, Eastern, Semple, Federal, Golden Hawk, Domada, Howe, Interstate, Metals Exploration, New Chicago, Pat, Quapaw, L. & G., Oko, Skelton, Tri-State Mining, Tri-State Zinc, Tulsa, United, and Velie.

At the annual meeting of the association October 22 at Picher 15 directors for the coming year were elected, as follows: J. F. Robinson, Commerce Mining and Royalty Company; Frank Childress, Childress Lead and Zinc Company; F. N. Bendelari, Consolidated Lead and Zinc Company; Charles A. Neal, Domada Lead and Zinc Company; C. F. Dike, Interstate Zinc and Lead Company; A. M. Gaines, New Chicago Mines Company; George Potter, Eagle-Picher Lead Company; P. W. George, Federal Mining and Smelting Company; T. F. Lennan, L. and G. Mining Company; S. H. Davis, Century Zinc Company; W. T. Landrum, Cortez-King Brand Mines Company; M. F. Owens, Black Eagle Mining Company; George Pearson, Lawyers Mining Company; George Provine, Tulsa Lead and Zinc Company; and E. Z. Wallower, Evans-Wallower Lead Company.

Addresses were made by Dr. George Otis Smith, Director of the U. S. Geological Survey, and H. Foster Bain, Secretary of the American Institute of Mining and Metallurgical Engineers.

The work of the safety department of the association was reported on by Fred Nesbitt. The safety work was described by C. F. Dike, president, as one of the greatest accomplishments of the association.

Dr. F. V. Merriwether, of the Bureau of Mines, made a report on the work of the Tri-State clinic, which is sponsored by the association in cooperation with the United States Bureau of Mines, the Metropolitan Life Insurance Company, and the mine operators of the district.

The report of the treasurer, Charles Neal, showed the association in an excellent financial condition, with cash reserves of more than $40,000.

Copper & Brass Research Association Elects Officers and Directors

At the eighth annual meeting of the Copper & Brass Research Association, held at its offices in New York City October 25, R. L. Agassiz, chairman of the Calumet & Hecla Consolidated Copper Company, was reelected president.

The following were elected members of the Board of Directors, the first nine comprising the Executive Committee:

R. L. Agassiz, chairman, Calumet & Hecla Consolidated Copper Company; Walter Douglas, president, Phelps Dodge Corporation; Thomas D'A. Brophy, Anaconda Copper Mining Co.; Stephen Birch, president, Kennecott Copper Corporation; Charles Hayden, vice president, Nevada Consolidated Copper Co., Ray Consolidated Copper Co., Utah Copper Company; John A. Coe, president, The American Brass Company; F. S. Chase, president, Chase Brass & Copper Co., Inc.; Edward H. Binns, president, C. G. Hussey & Company; Barton Haselton, president and general manager, Rome Brass & Copper Co.; J. W. Allen, treasurer, Greene Cananea Copper Co., Inspiration Consolidated Copper Co.; Charles F. Ayer, president, Magma Copper Company; Francis J. Bassett, sales manager, Taunton-New Bedford Copper Co.; Julian B. Beaty, vice president, Nichols Copper Company; H. C. Bellinger, vice president, Chile Exploration Company; J. C. Clendenin, director, Braden Copper Company; W. R. Webster, vice president, Bridgeport Brass Company; B. Goldsmith, president, The National Brass & Copper Co.; E. O. Goss, president, Scovill Manufacturing Co.; C. V. Jenkins, treasurer, Utah Copper Co., secretary-treasurer, Nevada Consolidated Copper Co., assistant treasurer, Ray Consolidated Copper Co.; William Loeb, vice president, American Smelting & Refining Co.; H. B. Paull, auditor, Calumet & Arizona Mining Co., New Cornelia Copper Company;

Sam A. Lewisohn, vice president and treasurer, Miami Copper Co.; C. M. Loeb, president, American Metal Company, Ltd.; Charles W. Clark, president, United Verde Copper Co.

At a meeting of the board of directors the following officers were elected: President, R. L. Agassiz; vice presidents, F. S. Chase, Walter Douglas, Barton Haselton, Thomas D'A. Brophy; treasurer, Stephen Birch.

William A. Willis, who has managed the association since its formation, was reelected to that position.

John F. Gowen was reelected secretary.

The following companies now comprise the membership of the association:

COPPER MINING, SMELTING AND REFINING COMPANIES

The American Metal Company (Limited), American Smelting & Refining Company, Anaconda Copper Mining Company, Arizona Commercial Mining Company, Braden Copper Company, Calumet & Arizona Mining Company, Calumet & Hecla Consolidated Copper Company, Chile Exploration Company, Green Cananea Copper Company, Inspiration Consolidated Copper Co., Isle Royal Copper Company, Kennecott Copper Corporation, Magma Copper Company, Miami Copper Company, Mother Lode Coalition Mines Company, Nevada Consolidated Copper Company, New Cornelia Copper Company, Nichols Copper Company, Old Dominion Company, Phelps Dodge Corporation, Ray Consolidated Copper Company, Shattuck Denn Mining Corporation, United Verde Copper Company, United Verde Extension Mining Co., Utah Copper Company, White Pine Copper Company.

COPPER AND BRASS FABRICATING AND DISTRIBUTING COMPANIES

The American Brass Company, Bridgeport Brass Company, Chase Brass & Copper Co. (Inc.), T. E. Conklin Brass & Copper Company, Dallas Brass & Copper Company, C. G. Hussey & Company, Mueller Company, The National Brass & Copper Company, New England Brass Company, New Haven Copper Company, New Jersey Wire Cloth Company, The Paper & Textile Machinery Co., The J. M. & L. A. Osborn Company, Rome Brass & Copper Company, Scovill Manufacturing Company, Taunton-New Bedford Copper Company, Foster Wheeler Corporation, Wolverine Tube Company.

American Zinc, Lead & Smelting Developing New Property

The American Zinc, Lead & Smelting Company is starting to develop its Jarnagan lease, comprising about 400 acres of land near Jefferson City, and is about 15 miles from its Mascot, Tenn., mine. Drilling has disclosed a good body of ore on the property, with values in places said to run as high as 9 percent and with an average of probably 4 percent, as against slightly under 3 percent in the upper levels of the Mascot mine.

A shaft is being sunk on the Jarnagan property, and when operations begin next year some time the ore will be shipped to the Mascot mill. The property is to be operated on a royalty basis.

Miners' Wages in Arizona Raised

Strength in the copper metal market is being reflected in wages paid to miners in Arizona. The principal mines of the state have announced a 10 percent increase in wages paid to its employes. The new wage schedule went into effect on October 1 and will remain as long as the metal sells above 15 cents per pound.

Phelps Dodge Driving Drainage Tunnel at Morenci

A drainage tunnel which will carry the water away from the Morenci mines of the Phelps Dodge Corporation is being driven from the level of Chase Creek near Clifton. The tunnel, when completed, will have a length of approximately 6,500 ft. It is being driven primarily for drainage, but it may later serve also for ore haulage. It already has a fairly large flow of water.

Argonaut Mill Robbed

Two masked men entered the mill of the Argonaut Mining Company, at Jackson, Calif., shortly before dawn on the morning of October 12, captured and bound the night watchman, and made their escape with gold precipitate valued at $5,000.

According to Silvio Zuccone, the night watchman, the robbers were doubtless familiar with the mill, as they had no difficulty in finding the precipitate. The robbers have not yet been apprehended.

Industrial First Aid Meet Held in San Francisco

The Pacific Coast Safety Conference and the Sixth Annual California First Aid Meet opened in San Francisco on October 17. The meetings lasted three days.

The first day was given over to the discussions of the Safety Conference, and the First Aid Contests followed on the second and third days.

In the First Aid Contests mineral producers were represented by eight oil company teams and five cement company teams. No metal mining companies and teams entered.

Prizes for the winning teams were presented at a banquet at the Clift Hotel on Friday evening, October 19. Frank H. Probert, dean of the College of Mining, University of California, acted as toastmaster.

Produce Pure Manganese by Vacuum Distillation Process

By a process of vacuum distillation, pure manganese is now being produced in the Bureau of Meallurgical Research of the Carnegie Institute of Technology. Successful purification of the metal by the distillation process has been achieved as the result of research by Dr. F. M. Walters, Jr., director, and Drs. V. N. Krivobok and J. B. Friauf, associates of the Bureau.

The purified manganese, the Carnegie metallurgists say, will be used in a comprehensive study of the system, iron-manganese-carbon. Although manganese is widely used in the steel industry, it has never been prepared in a pure form in any great quantity. The ordinary processes of reduction of manganese from its ores yield a product which is contaminated by several percent of impurities and the electrolytic method of refining which is so successful in the treatment of many metals is less readily applicable to the purification of manganese.

Metals of low melting point, such as mercury, cadmium and zinc, it is pointed out, have been purified by distillation. The method of distillation developed by Dr. Walters and his associates at Carnegie is considered as significant because of the high melting, 1,244 degrees C., of manganese.

The process used at the Bureau of Metallurgical Research is described as follows: Crude metallic manganese is placed in a pure magnesia crucible over which a similar crucible is inverted to condense the distilled metal. The crucibles are placed inside a silica tube 4 in. in diameter and 2 ft. long, which is closed at both ends and connected to a vacuum pump. The central portion of the silica tube is surrounded by a water-cooled copper coil of about 30 turns, through which an alternating current of several amperes at a frequency of some 20 kilocycles is passed. This induces eddy currents in the manganese and heats it to the melting point. The pressure maintained in the silica tube by the vacuum pump is less than a twenty-thousandth of the atmospheric pressure. The molten manganese boils under the low pressure and sends off manganese vapor, which is condensed in the upper crucible. The impurities remain in the manganese in the lower crucible, while the distilled metal which has been formed by the con-

densation of manganese vapor is of a high degree of purity.

The distilled manganese has a bright, silvery luster, which does not tarnish upon exposure to air. Unlike many pure metals which are comparatively soft and ductile, distilled manganese is extremely brittle and hard enough to scratch glass.

Samples of this material and the furnace in which it is produced were shown at an open meeting of metallurgists held on October 19, 1928, in Pittsburgh, under the auspices of the Metallurgical Advisory Board, which cooperates with the Department of Metallurgical Engineering of Carnegie Institute of Technology and the U. S. Bureau of Mines in a program of metallurgical research.

Zinc Mines of Tri-State District May Go On Five-Day Week

Most of the mines of the Tri-State district (Oklahoma, Kansas and Missouri) will adopt the five-day week as a means of reducing the zinc output of the field to a demand basis, operators have indicated recently. The Commerce Mining and Royalty Company adopted the short week early in October, and the lead of this company seems to have hit a receptive chord with the remainder of the companies of the field. The Commerce Company has been operating on the five-day schedule a great deal of the time for the past few months.

The five-day week was inaugurated in the field several years ago, but failed to materially reduce the output, because many of the companies worked only five days a week, but they failed to stop at 10 hours.

Fluorspar Duty Increased 50 Percent

Acting upon the report of the United States Tariff Commission that the duty on fluorspar in the Fordney-McCumber Act does not equalize the differences in cost of production in the United States and principal foreign producing countries, President Coolidge has issued a proclamation, effective 30 days from October 17, increasing the duty 50 percent. The new duty on fluorspar containing not more than 93 percent calcium fluoride is thereby increased from $5.60 per long ton to $8.40.

The additional protection was sought by domestic producers. The practical effect of the increase in duty will be to put the Pittsburgh market within the reach of domestic producers.

Mining Meeting At Nogales, Ariz.

Mining problems of Arizona will be considered at a "mining revival" to be conducted at Nogales, November 19-21, under auspices of the Arizona Chapter of The American Mining Congress, mining committee of the Chamber of Commerce, the Arizona section of the A. I. M. E., and the Arizona Industrial Congress. The purpose will be to advance mining in the Southwest.

Old prospecting methods will be discussed by W. B. Gohring, secretary of the Arizona Chapter, and by B. S. Butler, and electrical prospecting by J. J. Jakoskey, of Los Angeles. Dean G. M. Butler will speak of the service of the Arizona Bureau of Mines and Dr. R. L. Leonard on the geological survey of the Patagonia districts. H. A. Clark, governor of the Arizona Chapter, and Robert E. Tally, president of the Arizona section of the Institute, will be presiding officers at the convention sessions. H. B. Menardi, engineer of Los Angeles, will speak on development and treatment of complex ores by the flotation process. L. V. Root, of Kingman, will lead a discussion on the workman's compensation law. E. P. Mathewson will discuss business administration. J. H. Lerchen, of the Eagle Picher Company, will speak on test drilling at the Montana mine of the company.

Seneca Copper Reopens Mine

The mine of the Seneca Copper Mining Company in Michigan, which had been closed since June, 1927, was scheduled to reopen late in October as a result of the New York Stock Exchange's approval of an additional issue of 100,000 shares of common stock. The new stock has been sold at not less than $3 a share, which compares with the current market price of around $5 a share.

The Seneca Company was organized in Delaware in February, 1925, although the mine has been in production since 1920. Prior to the shutdown in June, 1927, the mine employed 386 men. On resumption of development and mining operations about 200 men will be employed.

Cessation of operations in 1927 was necessitated by the high cost of labor and supplies, the low price then prevailing for copper metal and the lack of funds for carrying on the business of the company, according to the company's application for listing.

M. B. Tomblin Dies

M. B. Tomblin, secretary of the Colorado Metal Association and secretary of the Colorado Chapter of the American Mining Congress, died in Denver, October 16, after a long illness. Mr. Tomblin was well known and active in the mining industry of Colorado and the West generally.

C. L. Colburn Succeeds Tomblin

C. Lorimer Colburn, prominent Denver mining engineer, has been selected as secretary of the state metal mining fund and the Colorado Mining Association by the directors of the organization, succeeding the late M. B. Tomblin.

During the war Mr. Colburn was a captain of engineers in the Army, and after his discharge he became assistant chief mining engineer of the United States Bureau of Mines. After more than two years in that position he was placed in charge of safety and efficiency work for the Bureau of Mines, with headquarters in Pittsburgh, Pa.

The Metal Mining Fund, used for the promotion of the best interests of the mining industry, is supported by a tax imposed by the state on mining properties.

MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD AND ZINC IN MONTANA, 1927

(In terms of recovered or recoverable metal)

Advance figures by C. N. Gerry, of the United States Bureau of Mines

County	Number of producers	Ore treated	Gold*	Silver*	Copper	Lead	Zinc	Total value
		Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Beaverhead	16	9,249	73.19	31,943	68,112	896,513	34,174	$87,215
Broadwater	25	12,978	2,140.01	60,102	16,595	1,342,549	49,232	168,222
Cascade	8	279,544	372.39	702,341	1,605,579	4,153,356	1,275,491	959,548
Deer Lodge	5	795	669.22	619	.....	.....	.....	14,185
Fergus	3	60	98.68	2,053	.....	.....	.....	3,204
Granite	26	57,615	1,489.32	262,246	30,809	226,972	364,131	221,119
Jefferson	37	40,941	1,969.93	321,808	224,420	1,639,930	1,278,260	437,711
Judith Basin	6	3,559	136.76	35,443	732	827,246	7,227	75,030
Lewis and Clark	33	34,862	10,299.86	59,032	35,454	129,545	68,040	263,548
Lincoln	3	5,002	52.53	5,488	4,960	362,760	583,569	65,050
Madison	57	22,240	8,656.22	41,263	178,663	328,438	.....	246,433
Meagher	4	1,412	1.60	699	15,148	212,152	.....	15,779
Mineral	6	471	57.71	10,317	229	157,449	162,147	27,369
Missoula	4	.....	29.61	.....	.....	.....	.....	612
Park	2	40	115.13	14	.....	.....	.....	2,388
Phillips	2	51	119.49	74	.....	.....	.....	2,512
Powell	23	517	942.10	8,305	403	72,949	3,247	29,041
Ravalli	1	.....	4.45	.....	.....	.....	.....	92
Sanders	1	45	.....	188	.....	10,961	8,604	1,349
Silver Bow	45	3,753,246	26,313.05	9,659,142	221,311,535	25,537,495	156,627,681	46,645,518
Total 1927	307	4,222,607	53,541.25	11,200,077	223,492,639	35,898,315	160,461,803	†49,265,925
Total 1926	393	4,470,055	60,564.11	12,769,092	255,372,862	42,306,193	147,401,507	‡59,410,453

* Includes placer production. † Average value of metals: Gold, $20.671835 per ounce; silver, $0.567 per ounce; copper, $0.131 per pound; lead, $0.063 per pound; zinc, $0.064 per pound. ‡ Average value of metals: Gold, $20.671835 per ounce; silver, $0.624 per ounce; copper, $0.14 per pound; lead, $0.08 per pound; zinc, 0.075 per pound.

Personal Items

Fred R. Mott, formerly general superintendent of the Virginia district for the Oliver Iron Mining Company now holds the same position for both the Virginia and Eveleth districts.

Henry Engels, a director and formerly president of the Engels Copper Mining Company, died in San Francisco on October 6.

W. H. Aldrich, assistant general manager, Inspiration Consolidated Copper Company, has gone to Chile, where he will be engaged on special work for the Andes Copper Company for two or three months.

Frederick Laist, metallurgical engineer for the Anaconda Copper Mining Company, has gone to the company's property in Poland.

E. J. Longyear, formerly president of the E. J. Longyear Company and now of Altadena, Calif., is in Europe. He has recently visited France and Germany.

E. S. O'Connor is now manager for the Utah Iron Ore Corporation, Desert Mound, Utah. He was formerly mine superintendent for the Mayville Iron Company, Mayville, Wis.

Abbott A. Hanks, of San Francisco, has returned from a three-months' European trip.

Ray H. Elliott, mining engineer of San Francisco, has returned from Peru.

W. G. Swart, mining engineer of Duluth, Minn., has been in the Southwest.

M. J. Elsing, mining engineer and geologist, of Bisbee, Ariz., has moved his headquarters to Tucson, Ariz.

Arthur B. Parsons, associate editor of the *Engineering and Mining Journal*, and long identified with the editorial and technical writing departments of that publication, has resigned to become vice president of the Mineral Research Corporation of New York.

Wm. N. Cummins has become associated with the Emmons Coal Mining Company in the capacity of vice president, with headquarters in the Packard Building, Philadelphia, Pa. Prior to his new connection, he was general manager of the Red Jacket Consolidated Coal and Coke Company, Columbus, Ohio.

E. H. Jenks, formerly chief engineer of the Cowanshannock Coal & Coke Company, has been appointed chief mining engineer of the Rochester & Pittsburgh Coal Company and will make his home at Indiana, Pa.

H. S. Estill, formerly general mine superintendent of the Stonega Coal & Coke Company, Norton, Va., has retired from the coal industry and will move to his former home at Lexington, Ky.

H. A. Treadwell has been made general superintendent of the Chicago, Wilmington & Franklin Coal Company, his second promotion in 10 months. He was superintendent of Orient No. 1 until the first of the year, when he was made chief operating engineer.

George Smith, Lexington, Ky., has been made mine inspector for the fourth district of Kentucky, embracing Bell, Knox, Laurel, Whitley, McCreary and Clay Counties. Sherman Green, of Central City, has been appointed inspector for the second district, embracing Daviess, Hancock, McLean, Muhlenberg, and Ohio Counties.

O. P. Hood, chief of the Technologic Branch of the Bureau of Mines, has returned from London, where he attended the World Fuel Conference held there early in October. In our last issue we incorrectly stated that A. C. Fieldner, F. G. Tryon, and H. H. Hill, of the Bureau, were also to attend the conference, but this was a misunderstanding. Mr. Hood presented several papers prepared by his colleagues in the Bureau.

J. T. Loree, vice president and general manager of the Delaware and Hudson Company, announces that C. E. Rolfe has been appointed general traffic manager, with offices at Albany, vice Mr. W. J. Mullin, retired. J. E. Roberts succeeds Mr. Rolfe as assistant general traffic manager.

Fiftieth Anniversary Dinner Is Tendered William G. Mather

In celebration of the fiftieth anniversary of his business association with the Cleveland-Cliffs Iron Company, and its predecessor, the Cleveland Iron Mining Company, a dinner was given to William G. Mather, president of the company, by officials and directors of the Cleveland-Cliffs Company in Ishpeming, Mich., September 24. The company has its mining headquarters in Ishpeming and 11 of the officials and managers of its Lake Superior district mining departments attended the dinner. Officials from the main offices of the company at Cleveland also were present. The dinner was served at the club house of the Ishpeming Golf Club. William G. Mather is a half brother of Samuel Mather, senior partner in the firm of Pickans, Mather & Company. The father, Samuel L. Mather, was the first president of the Cleveland Iron Mining Company. This company and the Iron Cliffs Company were consolidated in 1890, William G. Mather continuing his connection with the Cleveland Iron Mining Company as president.

Tin Trade Association Formed

Formation of the American Tin Trade Association, which will include the principal importers, dealers, brokers and importing consumers of pig tin, was announced October 25. The association will complement the newly formed National Metal Exchange, which will open its doors in November for the purpose of dealing in tin futures.

The object of the new organization will be to promote the best interests of the entire tin trade trade, to establish uniformity of commercial usage among its members, to acquire, preserve and distribute valuable business information and to adjust controversies and misunderstandings in the trade by arbitration.

To Produce Steel Direct From Iron Ore

The Department of Commerce reports that two large steel companies in Germany plan to conduct research work in developing a new method of producing steel directly from iron ore. After testing a number of processes, they are said to have decided to develop the "Norsk-Staal" method, by which steel is produced at low temperatures with gas. In this process the iron does not become fluid, and the finished product is of a spongy consistency. It is said that the consumption of gas is not excessive in this process as it is used repeatedly for reducing the ore. Large quantities of electric current are required, which can be produced at low cost by using by-product gas. Construction work on an experimental plant has been started, and it is estimated that its yearly production of steel will amount to 20,000 tons. If results are satisfactory steel may be produced by this method on a large scale.

Mineral Industry in Mexico Satisfactory

Satisfactory conditions prevail in the Mexican mining industry, according to a survey that has been made by the Mexican bureau of mines. The mining industry as a whole is in a good condition despite the decreases in the price of silver, lead and zinc, the principal metals that Mexico produces, the survey shows. The review covers the first six months of 1928.

The report stresses the fact that the slight increase in silver quotations during the months of May and June had a notable effect on the production of this metal in Mexico. Prices of lead and zinc which fell off during this period did not, however, interfere with production of these metals, and their output continued to increase in the same ratio as prior to the drop in their prices.

Companies that were most affected this year have been those operating on a small scale that treat zinc and lead ores exclusively and have been unable because of their own conditions to reduce production costs.

Seven dredges are now at work extracting gold from gravel in the vicinity of Fairbanks, Alaska, according to reports received by the Department of the Interior. Six months ago but two dredges were operating in this district

EXCELLENT PROGRAM ARRANGED FOR NATIONAL COAL ASSOCIATION MEETING

If the number of hotel reservations several weeks in advance of the meeting date mean anything, there will be a splendid attendance at the Eleventh Annual Meeting of the National Coal Association, to be held at the Hotel Cleveland, Cleveland, Ohio, November 14, 15, and 16. What is more, operators from the many producing fields report that there is an exceptional degree of interest in the approaching event, due to a growing realization of the absolute need of collective effort within the industry to meet the numerous and divers questions which press for consideration.

A program has been developed with an eye to rendering the greatest degree of service to the bituminous coal operator. Impressed with the fact that these annual gatherings afford an unexcelled opportunity to strike a keynote that is felt in every operating field, the officials of the nation-wide organization of bituminous operators have built up a program of four general sessions which is rich in possibilities of substantial service. Realizing the importance of the factor of attendance in generating momentum for any effort which might be launched, the leading figures in the industry are leaving nothing undone to stimulate interest in the Cleveland meeting. As has been indicated by way of report on hotel reservations, the response is most gratifying, and it would appear at this writing that every section of the country where bituminous coal is produced will be well represented. As has been the custom for several years, invitation is extended to nonmember as well as to member, operators to attend this gathering and to participate in the discussions.

There will be three principal talks. S. A. Taylor, of Pittsburgh, former president of the American Institute of Mining and Metallurgical Engineers, will present facts and figures bearing on the cost of maintaining excess potential capacity. T. W. Harris, Jr., purchasing agent of the du Ponts and vice president of the National Association of Purchasing Agents, will set forth the position of the purchasing agent and will stress the point that coal should be sold not on price alone but rather on the bases of quality and use. A well-known banker will give a general survey of business and will outline the relationship of bituminous coal to the industrial world.

The closing session will be featured by a discussion of the trade practice movement which is being promoted by the Federal Trade Commission. The advisability of a trade practice conference of bituminous operators under the auspices of the Commission will be considered. This movement has to do largely with determination of trade practices detrimental to an industry, and the Federal Government has given its support and encouragement on the theory that the movement leads to self-regulation of industry.

In each of the four general sessions there will be discussion of the work of the several committees of the National Association, covering taxation, public and Government relations, research, marketing, safety and membership. Attention will be given to proposals for Federal legislation, with special reference to S. 4490, which is the bill framed by the United Mine Workers of America and introduced by Chairman James E. Watson, of the Senate Interstate Commerce Committee, shortly after the close of the coal hearings before that committee last May. The effect of the enactment of such legislation on the industry will be analyzed and the status of the effort to promote the passage of the bill will be studied.

As usual, there will be a banquet on the evening of the second day of the meeting. This affair, as is the case with the business sessions, will be held at the Hotel Cleveland, and will be marked by an unusual program of wit and humor. Captain Irving O'Hay, one of the heroes upon whom Richard Harding Davis based his "Soldier of Fortune," will be among the speakers. Selections by the Red Arrow Quartet of the Pennsylvania Railroad Company will be among the entertainment features.

Mines Abandon Power Plants and Buy Energy

According to a report on the utilities industries by the W. B. Foshay Company, mining companies throughout the country are buying to an increasing extent their electrical energy from public utility companies. The report states:

"During the last six months there has been a sharp increase in the number of mines that are buying all or part of their power from utilities organizations. Formerly coal-mine operators generated their own electricity, but in many instances for average coal-mine plant 20 pounds of coal were burned to produce 1 kilowatt hour.

"As large modern electric plants produce this same energy with less than 2 pounds of coal, a great conservation of fuel has taken place and the cost of power in mining coal has been lowered."

Indiana Miners and Operators Agree on New Wage Scale

Indiana miners and operators on October 18, at Terre Haute, Ind., signed a new wage scale agreement to supplant the old Jacksonville scale, closing a five weeks' session of the scale committees of the miners and operators. The new contract provides for $6.10 per day for day wage men and 91 cents a ton for men on a tonnage basis, the same scale as adopted several weeks ago in Illinois, and extends to April 1, 1930. Motormen and trip riders will receive $6.85 and $6.25, respectively. The rate for machine loaders was fixed at $9, which also applies to cutting-machine operators.

It is understood the arbitration clause provides that in case of a disagreement between operators and miners an attempt is to be made to select a third party as arbitrator. Should that fail a list of three men, each the president of some college in the State of Indiana, is to be taken. The miners are to strike off one name, the operators to strike off one name, and the remaining man is to be arbitrator with full power to either act himself or appoint anyone he may elect to so act.

According to Harvey Cartwright, president of District 11, United Mine Workers, some 9,000 men have been working in Indiana this fall under individual agreements. He estimated that 6,000 other men, whose companies remain under the old agreement, were out of work by virtue of failure of the mines to operate, and that 3,000 others were idle by reason of a failure of their employers to sign individual agreements.

Iowa Coal Miners Ratify Wage Scale

Iowa coal miners, in a referendum, October 12, ratified the action of the joint scale committee of the operators and the union in establishing a new wage scale based on $5.80 a day minimum. The vote was: For the new scale, 3,635; against, 1,644.

Wage scale committees of the miners and operators reached an agreement late in September. The day wage under the new contract is on a $5.80 basis for all classes of labor formerly receiving $7.50 a day under the Jacksonville scale. Under the new agreement $5.65 will be paid for other adult underground labor, $3.50 and $3.85 for trappers, oilers, couplers, etc. Top men will receive a day wage of $5.18.

Western Pennsylvania Operators Form Traffic Bureau

A merger of the three existing coal rate committees in the Pittsburgh district took place the middle of October. The new organization, to be known as the

Western Pennsylvania Coal Traffic Bureau, absorbs the Pittsburgh Operators' Lake Rate Committee, the Pittsburgh Eastern Coal Rate Committee, and the Pittsburgh Northern Coal Rate Committee.

The new traffic bureau, at its organization meeting, elected the following directors: J. D. A. Morrow, president, Pittsburgh Coal Co.; S. Pemberton Hutchinson of Philadelphia, president, Westmoreland Coal Co.; T. W. Guthrie, vice president, Hillman Coal & Coke Co.; H. T. Wilson, president, Pittsburgh Terminal Coal Corp.; George H. Francis, secretary, Keystone Coal & Coke Co.; B. H. Canon, general manager, Clinton Block Coal Co., and R. Templeton Smith, secretary, Poland Coal Co. A. B. McElvany was elected secretary of the new body. The work of the Western Pennsylvania Coal Traffic Bureau will be similar to that of the former committees, it was stated, except that it will "function in a broader way and more constantly and aggressively."

Truax-Traer Coal Company Takes Over Illinois Properties

The Truax-Traer Coal Company, Chicago, the largest operating company in the state of North Dakota, with coal stripping plants located at Kincaid and Velva, N. Dak., has acquired the properties of the Black Servant and Forsyth Coal Companies in Jackson County, Ill. Walter H. Cunningham, who has been president of the West Virginia Southern Coal Company, has assumed the presidency of Truax-Traer Coal Company, and the Truax-Traer Coal Company will act as the exclusive sales agent for the West Virginia Southern Coal Company's coals.

Charles M. Riker, who has been the Chicago manager for the West Virginia Southern Coal Company, and vice president of the West Virginia Southern Coal Sales Corporation, has been made western sales manager for the Truax-Traer Interests. Frank Barthelme, manager of sales for the Truax-Traer Coal Company, will have his headquarters at the company's offices in the First National Soo Line Building, Minneapolis. M. L. Patton, manager of sales for the West Virginia Southern Coal Company, goes with the Truax-Traer organization November 1, with particular reference to the distribution of West Virginia Southern Coal Company's coals.

Frank Enslow, of Huntington, W. Va., who has been vice president of the West Virginia Southern Coal Company, has been elected to the presidency of that company, succeeding Mr. Cunningham, who continues on the board of directors. Mr. Cunningham will continue his residence and present offices in Huntington.

Rochester & Pittsburgh Reorganizes

Effective October 1, the Rochester & Pittsburgh Coal Company was reorganized and a controlling interest in it acquired by the Helvetia Coal Mining Company, a new company formed by the consolidation of the Pittsburgh Gas Coal Company, the Cowanshannock Coal & Coke Company and the Brush Creek Coal Mining Company. The Rochester & Pittsburgh and Helvetia coal properties are situated in the Reynoldsville district of the Central Pennsylvania region and comprise 20 mines with a daily capacity of 35,000 tons.

Louis W. Robinson, chairman of the board of the Rochester & Pittsburgh, who has been in charge of it and the affiliated companies for 46 years, is retiring to devote his time to private interests. B. M. Clark, who has been president of Rochester & Pittsburgh for the past 10 years, will continue as the head of the new organization, with headquarters at Indiana, Pa. J. Noble Snider will continue to head the sales department as vice president. L. W. Householder has been made vice president in charge of operations, and Heath Clark has been appointed vice president, both with headquarters at Indiana.

Ask Revenue Bureau to Segregate Anthracite and Bituminous Income Tax Reports

The Internal Revenue Bureau has been requested by the National Coal Association to publish annual income tax reports separately for bituminous and anthracite mining companies. Heretofore all of the coal mining companies have been grouped under one heading "coal mining." The association says the statistics will be more valuable if they are segregated into the two classifications.

Illinois Operators Reorganize

The Coal Operators Association of Illinois was reorganized on October 17 under the name of "Illinois Coal Operators Labor Association."

At the first meeting of the new association, held in Chicago, on October 18, the following officers were elected: Executive Board, W. J. Jenkins, chairman; D. W. Buchanan, John Henderson, J. E. Hitt, M. F. Peltier, F. S. Pfahler, and Paul Weir. Treasurer, L. H. Smith.

At the first meeting of the executive board, held immediately after the adjournment of the first meeting of the members, Joseph D. Zook was elected president and chief commissioner of the new association, and he will devote his entire time to the affairs of the association as quickly as he can fully divorce himself from his duties as vice president and general manager of the O'Gara Coal Company.

Under the terms of the new articles of constitution and by-laws adopted on October 17, all operators having mines in the State of Illinois are eligible for membership. Many operators who did not hold membership in the old association have already made application.

A. E. S. C. Approves "Outside Coal Handling Equipment" Standards

"Outside Coal Handling Equipment" (M 10, 1928), a standard originated and developed by a committee of the Standardization Division of the American Mining Congress and submitted by them, as sponsors, to the American Engineering Standards Committee, has been approved by that body as a Tentative American Standard.

This code covers standard system of signals for hoisting and lowering, requirements for devices used on hauling men on inclines; requirements for devices used in hoisting and lowering men in shafts; practice in safety methods around the tipples, including handling railroad cars, loading booms, railroad clearances and clearances for overwind; fire-protection shafting, hose-coupling threads, and private fire equipment; transmission shafting, machinery shafting, pedestals and bearings, belt and gear drives, etc.

Advocate Expansion of W. Va. School of Mines

The development of the School of Mines of West Virginia University, in keeping with the importance of the mining industry in West Virginia, is one of the recommendations contained in the biennial report of the state board of control. In regard to the School of Mines, C. R. Jones, dean, of the College of Engineering, declares that the need in West Virginia for the highest type of training in coal mining, and the importance of the mining industry, make the erection of a new building of first consideration in the building program of the university.

The tremendous development of the chemical industries in the Kanawha Valley is reflected in the statement of Dean Jones, who says that the department of chemical engineering has made rapid progress and is cooperating in almost an ideal way with the growing chemical engineering industries in the state. The work of the department, he says, includes metallurgy, metallography, ceramics, industrial chemistry, oil refining and water testing and purification, in addition to subjects ordinarily handled by chemical engineering departments.

High Schools to Have Coal-Mining Courses

Pleas of Robert M. Lambie, chief of the state department of mines, for the in-

clusion of courses in mining among the optional subjects offered to high-school students have resulted in the adoption of mining courses by two high schools of the state, according to an announcement made here by Prof. Charles E. Lawall, head of the Mining Engineering Department at West Virginia University.

Both of the high schools which have included the mining courses in their curricula are in the southern part of the state, one at Gary and the other at Berwin. A third high school, located at Williamson, has made a request for an outline of a mining course to be used next year, Professor Lawall said.

Speaking of the inclusion of the mining course in studies offered to high-school students, Professor Lawall said that "it is the first step in a great program and the beginning of a movement to teach high-school students the fundamentals of their state's greatest industry."

The mine course was outlined for the high schools by the University School of Mines, which cooperates with the schools in conducting the classes. Classes are held on five mornings of each week by the regular science teachers at the schools.

Styled as "Elementary Coal Mining," Professor Lawall said the course includes virtually all phases of mining and added: "For years vocational agriculture has been given in many of the schools of the state, many of which are in the center of important coal-mining regions. We feel that the high-school students should become more interested in mines, when they live in the center of such regions, rather than agriculture, which is found only in certain sections of the state."

To Establish Research Bureau for Anthracite Industry

A research bureau for the anthracite industry is to be established shortly, following plans discussed at a three-day conference of operators and experts held at Lehigh University, Bethlehem, Pa., the latter part of September. The bureau will consist of three divisions—Production, Utilization, and Research—and will have its own laboratory.

The conference was attended by a number of anthracite operators, and by Dr. C. R. Richards, president of Lehigh University; Dr. S. W. Parr, president of the American Chemical Society; Henry Kreisinger, of the Combustion Engineering Corporation, New York City; and Dr. A. C. Fieldner, Chief of the Experimentation Station Division of the United States Bureau of Mines.

The conference was presided over by S. D. Warriner, chairman, and D. T. Pierce, vice chairman of the Anthracite Operators' Conference.

ANTHRACITE OPERATORS CREATE TRAFFIC BUREAU

The Anthracite Operators' Conference has created a traffic bureau, and Andrew K. Morris has been appointed to head this activity with the title of traffic commissioner for the industry, with headquarters in New York.

Mr. Morris has resigned his position as vice president and general manager of the Pennsylvania Coal Company and Hillside Coal and Iron Company. The scope of Mr. Morris's new duties includes the effort to secure reasonable adjustments of rates, when necessary to meet competition and retain or extend anthracite markets. He will also represent the industry in all rate cases, and conduct a continuous study of rates in relation to marketing conditions, competing soft coal rates, comparative rates on domestic and steam sizes, etc.

Coal Merger Plan in Southern West Virginia Dropped

Failure of the executive committee representing coal operators in the smokeless field of southern West Virginia to secure enough companies representing 30,000,000 net tons annual production, to consolidate, has resulted in the abandonment of the plan to effect a merger of the coal properties in that section of the state. The proposition to merge the companies has been in progress since early this year and many meetings have been held.

The executive committee, representing the mine owners, held a meeting late in September in New York, and at its conclusion the announcement was made that the proposition to merge had been abandoned. The statement handed out read:

"The executive committee that has for some months past been working on the merger of coal properties in the smokeless field of southern West Virginia decided, at a meeting held in New York today, to abandon its efforts to form a consolidation.

"Plans for the merger have been made on the condition of securing for the merger companies representing at least 30,000,000 net tons of annual production. The committee has been unable to secure the cooperation of sufficient companies to meet this minimum requirement."

Lake Cargo Cases Before Supreme Court

Chief Justice Taft announced recently that the lake cargo coal rates cases, involving an injunction prohibiting the Interstate Commerce Commission from stopping southern railroads from making a 20 cent reduction on coal to lake ports, seemingly is properly before the Supreme Court.

Under the rules of the court, it was necessary for the United States and the Interstate Commerce Commission, the Barton Coal Company, the Pittsburgh Operators Lake Rate Committee and the Baltimore and Ohio and other northern railroads seeking to set aside the restraining order issued by a statutory federal court at Charleston, W. Va., to file with the court statements showing the questions at issue, and the jurisdiction of the Supreme Court to pass on them.

Taft said after examining these jurisdictional briefs in all the cases "the court finds that probable jurisdiction had been shown." This means that the jurisdictional question, never considered serious in these cases, has been passed, and that the cases are now in line to be heard on the appeals.

Kanawha Coal Operators' Association Holds Annual Meeting

Col. W. M. Wiley, vice president of the Boone County Coal Corporation and director and manager of that firm's output in Boone and Logan Counties, W. Va., was elected president of the Kanawha Coal Operators' Association at the annual business meeting of the association held at the Kanawha Country Club, Charleston, W. Va., October 18. Mr. Wiley is a member of the board of directors of the United tates Chamber of Commerce and lives at Sharples.

The association also reelected as its secretary Duncan C. Kennedy, of Charleston. Mr. Kennedy was elected for the twenty-fifth time and was the recipient of many personal congratulations from operators with whom he has served.

The new board of directors consists of C. A. Cabell, the retiring president, L. M. Webb, Frank M. Enslow, J. D. Christian, Frank O. Harris, John Laing, W. C. Mitchell, John McKeever and W. M. Wiley. An executive committee, consisting of President Wiley, C. A. Cabell, and Frank O. Harris, was appointed. Mr. Harris was elected vice president of the association and John L. Dickinson treasurer.

Following the morning business session, luncheon was served to the Kanawha operators and their guests at the Kanawha Country Club and a golf tournament followed.

Final 1927 Coal Figures

Revised statistics of the Bureau of Mines placed the 1927 output of bituminous coal at 517,763,000 net tons. This compares with 573,367,000 net tons in 1926. Anthracite output in 1927 was 80,096,000 net tons, against 84,437,000 tons in 1926.

Restriction of Carbon Black Production Sought in Louisiana

Louisiana plans ultimately to stamp out from the state the industry engaged in the manufacture of carbon black. This was made known by its attorney general, Percy Saint, in a brief presented to the U. S. Supreme Court in opposition to an appeal by J. S. Herkness from a decision of a district court which upheld the conservation commissioner of Louisiana in his refusal to grant Herkness a permit to manufacture carbon black. The position of the state is that the use of natural gas in the manufacture of carbon black is wasteful and will tend to exhaust its natural gas resources. The state officials claim that the use of natural gas for industrial and domestic purposes is more desirable. The case involves the right of Louisiana to prevent the extraction of natural gas for the production of carbon black. Herkness, who brought the case, owns 80 acres of land and gas rights on 760 other acres in the Monroe gas field. He purchased the property in 1925 for $212,000 and claims that it has no value except for its natural gas and its utilization in the production of carbon black. The case originated when the conservation commissioner of Louisiana declined to issue a permit to Herkness for construction of a factory for producing carbon black. Herkness said that under a permit granted by the state, he has drilled two producing gas wells on his land. He claims that the Louisiana Legislature has not prohibited the use of natural gas for the production of carbon black, but has authorized its use under certain conditions, with which he is willing to comply. The conservation commissioner says no permits for the use of natural gas in the production of carbon black have been issued since 1924.

The case has been argued before the Supreme Court, which will shortly hand down its decision. John W. Davis argued the case for Herkness, while state authorities submitted their defense on their brief. The brief states that the conservation commissioner has been reducing the quantity of natural gas by owners of wells already operating "with the end in view of ultimately stamping the industry out in this state without too heavy a loss to those engaged in it." It is stated that at one time there were used from 450,000,000 to 500,000,000 ft. of natural gas per day in the production of carbon black. Since March, 1926, the amount of natural gas that may be used for the production of carbon black has been reduced to 275,000,000 ft. per day. The state contends that the conservation of the supply of oil and natural gas is necessary to the individual states and to the Nation and that the owner of lands from which natural gas is taken does not have full ownership of such gas until it is reduced to his possession. Until such possession is had, the state has the right of control of the natural gas. It is contended by the Louisiana officials that the greatest economic waster of the Nation's supply of natural gas is the carbon black manufacturer. It is also contended that a state can absolutely prohibit the manufacture of carbon black. Since 1924 no permits have been issued by Louisiana for construction of carbon black plants, and the product of existing plants is being gradually reduced by the state. It is said that the policy of the state is to gradually suppress the business with as little injury as possible to those who had already invested in it. The brief declares that present carbon black plants may continue in business, "subject to a gradual reduction of production and an ultimate suppression," and that they shall "gradually stop making carbon black."

—Darling in the New York "Tribune"

The Political Marathon Dancers

—Richmond (Va.) Times-Dispatch

Anything But Mild

WITH THE MANUFACTURERS

Cutting Heavy Grades at Bell & Zoller Mine

An interesting statement of the performance of the Illinois Power Shovel has just been issued by the manufacturers. They say:

"The cutting down and adjusting the heavy permanent haulage ways at the Bell & Zoller Coal & Mining Company at Ziegler, Ill., has been recently handled in a most economical way within the past few months at Bell & Zoller No. 2 mine by Mr. Paul Weir, vice president.

"Two men with a National Conway shovel, manufactured by the Illinois Power Shovel Company at Nashville, Ill., and with the assistance of a road motor, loaded out from 80 to 100 tons of rock per day, switched their own loads, laid their own track as they advanced, greased their machines, and did all necessary labor attached to the development and progress of the grading.

"In preparing the ground for the shovel, a portable compressor was used to drill the rock, which enabled the drill crew to keep the compressor close up to the drills. Particular attention was given to the drilling, so that the earth along the ribs would be well taken care of and broken up. As soon as the grade is well drilled from all points, the track is then removed back to where the cut is ready to be loaded out. The ground is then shot and the loading game begins.

"A switch was laid through a cross cut and down the back entry, where enough track storage was made to enable them to place enough cars for a day's loading. In the evening, at quitting time, the motor would couple on all loads and take them to the bottom, where they were hoisted immediately after quitting time. In the morning the motorman brought his own empties in; thereby the complete operation of taking care of the cut did not disturb the operation of the mine.

"The shovel is operated by one man, who sits on the right side of the machine, using his feet to propell the loader back and forth on the track and using both hands to operate the dipper. The dipper is 36 in. wide and is attached to the end of a boom which is used to convey the material by gravity from the dipper to the belt conveyor.

"The advance of the clean-up depends altogether upon the depth of the cut. Some places the cut was 7 ft.; other places, 4 ft. deep. Other than the one-man operator and motorman there is no necessity for additional labor. When it is necessary to lay track the operator backs the machine up, he and the motorman pick up a short section of track which is supplied with steel ties, attach the short section to the main track by ordinary fishplates, and track arrangements are again in shape to advance another 6 or 7 ft. When they have advanced 30 ft., a long section replaces the short sections, thereby giving better trackage arrangements for the loads, and the short sections of track are carried ahead for future advancement.

"Mr. Berger, the superintendent, and Mr. Taake, the mine manager, together with Mr. Carter, the electrician, all deserve great credit in the development of the very economical system of handling the grading problem at the Bell & Zoller mine.

"The same crew of two men is equally as effective, if not more so, in cleaning up heavy falls or brushing main entries. In this respect advancement is more rapid on account of the track having been laid prior to the fall of slate or rock."

The National Conway Shovel in Bell & Zoller's No. 2 mine

Nordberg Manufacturing Company Consolidates With Symons Brothers Company

The consolidation of Symons Brothers Company with the Nordberg Manufacturing Company is of particular interest to those industries where crushing processes are involved. This brings together one of the leaders in the crusher field with a company long prominent in the design and building of large and highly efficient machinery particularly well known in the mining field.

For the past 25 years Symons Brothers Company has been engaged in the building of crushers. It has been the constant aim of this company to improve the quality of its product and to render the crushing industry a real service by giving it machinery of improved performance. The experience gained from earlier design later led to the Symons Horizontal Disc Crusher. Then followed the Vertical Disc Crusher, both of which had many advantages over the types formerly used for the same service.

Guided by past experience and realizing the decided advantages of a machine which would incorporate the good qualities of both types of disc crushers next led to the Symons Cone Crusher. This new design marked a new process of crushing, one which met with ready favor with those engaged in crushing operations. The successful performance of this type of machine is evidenced by its use in the largest mining companies, stone and gravel plants in the United States and many foreign countries. In the comparatively short time since its development, it is safe to say that more Symons Cone Crushers have been installed for reduction or secondary crushing than any other type built.

This consolidation permits of a more advantageous use of the exceptional manufacturing facilities of Nordberg ideally suited for crusher manufacture. The building of crushers by the Nordberg Manufacturing Company is by no means a new venture. For some time a large proportion of Symons Crushers have been produced in the Nordberg plant. Here have also been built the largest hoists, compressors and Diesel engines found in mining service. Also included among Nordberg Products are the Nordberg-Butler Shovel, an air-operated machine for loading underground

in drifts and tunnels, and the Track Shifter, now used for shifting track in many of the open-pit mines and large quarries. The addition of Symons Cone Crushers is therefore in keeping with the other products of Nordberg.

With the Symons Brothers Company becoming a part of the Nordberg Manufacturing Company, a continuance of past policies is assured. The same representatives engaged in the sale and servicing of Symons Crushers will continue to do so in the future.

The Crusher Department will be transferred to the main office of the Nordberg Manufacturing Company at Milwaukee. Branch offices will be continued at New York and Los Angeles.

Dravo-Doyle Appoints Distributor

The Ilg Electric Ventilating Company of Chicago have appointed the Dravo-Doyle Co., Pittsburgh, Pa., distributors for Ilg Blowers, Unit Heaters and Power Ventilators. The complete Ilg outfit, motor and blower is built and tested in one factory, giving complete protection under the nameplate and guarantee. Today there are almost 10,000 Ilg Unit Heaters installed, approximately one-third of which represent repeat orders from more than 750 users.

This company also represents the Ames Pump Company, manufacturers of a high-grade Centrifugal Vacuum Pump for heating systems.

Jeffrey's New Bucket Elevator Catalog

One hundred and eighty-four bucket elevators of different styles or sizes, with capacities from 6½ to 750 tons an hour, are offered in the new Bucket Elevator Catalog No. 465, now ready for distribution by the Jeffrey Manufacturing Company, of Columbus, Ohio.

Thirty pages of engineering drawings illustrate the many types of chains, buckets and casings used in standard Jeffrey elevators; and 22 photographs show the elevators doing almost every sort of work an elevator may perform.

The catalog also lists 41 typical materials, giving their weights per cubic foot of volume and designing the type of elevator best suited to lift them. Using this list, a manufacturer can easily decide which elevator will best handle his particular material.

The catalog specifies steel casings in two forms, the riveted plate and angle and the spot-welded flanged construction.

A new feature described in Catalog No. 465, page 45, is the Silent Ratchet Safety Lock that may be supplied with any bucket elevator. This device provides absolute protection against spilling a loaded elevator when an unexpected interruption of power occurs. It will prevent the heaviest load from slipping backward.

Link-Belt Introduces Portable Flight Conveyor in Three Sizes

The newest member of the Link-Belt Loader family to enter the coal trade is a Portable Flight Conveyor, furnished in 21, 26 and 31-ft. lengths. The new machine bears a strong family resemblance, showing the usual sturdiness of construction and assurance of durability and service, but it has been specially "trained" for the handling of all sizes and grades of coal and coke—from the smallest to the largest sizes.

The framework is well braced and rigid, made of angles and plates. All

frame and trough members are bolted, and can be easily renewed when necessary. Axles are of the swivel type, easily adjustable for different positions.

A double strand of chain with special attachments constitutes the conveying medium, which moves at a speed of 124 ft. per minute through a 24-in.-wide trough. Materials are conveyed at the rate of 60 cu. ft. per minute, a ton and a half every minute when handling coal.

The motor is completely enclosed by a sheet metal housing and all gears are protected by guards. The head shaft is driven from a countershaft with suitable reduction gearing by a 5 hp. motor.

The raising and lowering mechanism for the conveyor is accomplished by a chain arrangement of worm gearing and drive.

Like the portable belt conveyor, the flight machine may be operated in conjunction with an overhead L-beam trolley, chain block and bail. It may also be fitted with a screening chute and screens of the woven wire or bar type, depending upon the material to be handled, when desired.

The Donner Steel Company of Buffalo, N. Y., has ordered three more 300-hp. Oil-Electric Locomotives to be built jointly by the Ingersoll-Rand Company, the General Electric Company and the American Locomotive Company.

This company already has one of these units in operation.

Mining Companies Place Orders for Hoisting Machinery

Nordberg Manufacturing Co., Milwaukee, has received an order for Hecla Mining Co., at Burke, Idaho, calling for two electric hoists, each weighing approximately 500,000 lbs. The contract for the electrical equipment of the two hoists was placed with the Allis Chalmers Co. The combined contract of the two Milwaukee concerns is $300,000.

Another order was placed by the Consolidated Copper Mines Corporation of Kimberly, Nev., and calls for a 400,000-lb. automatic electric, double-drum hoist.

Two of the largest hoists ever built in America have just been completed by the Nordberg plant for shipment to the International Nickel Co., at Copper Cliff, Ontario. The shipping weight was approximately 700,000 lbs. each.

New Chief Engineer for Cutler-Hammer

N. L. Mortonsen has been appointed chief engineer for the Cutler-Hammer Manufacturing Co., Milwaukee. Mr. T. E. Barnum, former chief engineer, has been appointed consulting engineer for the company, in which position he will be able to give uninterrupted attention to engineering problems and outside engineering relations.

Mr. Mortonsen has been connected with Cutler-Hammer for 21 years, the last 5 of which have been as assistant to Mr. Barnum. Articles by him have appeared frequently in the technical press and he has delivered numerous papers before electrical societies. He is a fellow of the A. I. E. E. and a member of the A. I. S. E. E.

Speed Reducer Catalog

The D. O. James Manufacturing Company, 1120 West Monroe Street, Chicago, have just completed and published their Speed Reducer Catalog No. 166, which describes, illustrates and lists completely every type of speed reducer made—Planetary Spur (direct, angle and vertical drives), Heavy Duty Worm (direct and angle drives), Medium Duty Worm (direct and angle drives), and Herringbone (direct and angle drives).

This book should be of extreme value to all engineers interested in speed reducers in that it is the only complete work on this subject; further, it is written and compiled in a simple, concise, well-illustrated form which makes for easy reference.

A copy of this 160-page catalog may be obtained by writing to the D. O. James Manufacturing Company.

New Western Union Wood Preservative

"A Technical Discussion on Zinc Meta Arsenite" is the title of a new booklet issued by the Curtin-Howe Corporation, timber preservation engineers. Zinc Meta Arsenite is the wood preservative developed by the Western Union Telegraph Company for its own use, and now being handled commercially by the Curtin-Howe Corporation.

The booklet is made up of three sections. Part 1 is entitled "Chemical Reaction of Wood Destroying Fungi." This was an address before the American Wood Preservers' Association at Montreal last January, by Dr. L. P. Curtin, chemist of the Western Union Telegraph Company.

Part 2, entitled "Chemistry and Toxicity Data" was prepared by Dr. Curtin as a supplement to Part 1.

Part 3, "Weathering and Field Tests," is a paper presented before the American Wood Preservers' Association at Montreal last January by Paul J. Howe, construction engineer, Western Union Telegraph Company.

Timber users will be interested in this discussion of a preservative said to produce clean, odorless, paintable forest products. Copies of the booklet may be obtained upon application to the Curtin-Howe Corporation, 11 Park Place, New York City.

New Mine Locomotive Literature

New literature released recently by the Westinghouse Electric & Manufacturing Company includes two new publications on mine locomotives. Large Main Haulage Mine Locomotives—Reprint 336—is a description of the equipment and performance of superpowerful haulage units which are recommended for increasing the capacity of the main haulage way.

The Importance of Equalization in Locomotive Design—Reprint 337—is a discussion of the evolution of equalization in transportation vehicles and the advantages of its application to mine locomotives.

Copies of these publications may be obtained from any district office of the company or from its Advertising Department at East Pittsburgh.

"The Wasp & Hornet Engines and Their Use of Nickel Steels" (12 pages, 8½ x 11 in.) is the title of a pamphlet issued by the International Nickel Co. Essential features of design of the Wasp and Hornet Fixed Radial Type Air Cooled Engines and a discussion of the materials used in their construction. General specifications of both engines are given, with power and fuel consumption charts and photographs of numerous typical installations in military naval and commercial service.

Mine Telephones and Accessories

The Graybar Electric Company, New York City, distributers of Western Electric products, very aptly present the case for mine telephones in an interesting pamphlet just issued entitled "Mine Telephones and Accessories." Several different telephone sets are described and illustrated, including one which bears the approval plate of the United States Bureau of Mines for use in explosive atmosphere.

Portable Electric Hoists

Sullivan Machinery Company has issued a catalog entitled "Sullivan Portable Electric Hoists," which includes sizes from 10 to 35 hp., in both single and double drum patterns. These hoists are being used extensively for scraper loading service in both metal mines and coal mines, and also for dragline service in quarrying and contracting work.

The Hercules Powder Company has available for distribution two booklets entitled "High Explosives and Blasting Powders," and "Blasting Supplies."

The Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York City, has issued several new equipment bulletins which mining men should find interesting. They are entitled: "Duplex Air Compressors," "Air and Gas Compressors" (straight line, steam and power driven), "Giant Semi-Diesel Oil Engines," "Vertical Duplex Compressors," "Portable Compressors," and "Vertical Simplex Air Compressors."

Among the recent catalogs published by the General Electric Company are "Electric Heat in General Electric Factories," "Silent Gears," "Automatic Switching Equipment for Synchronous Converters in Mining Service," and "Crane and Hoist Motors."

PERFORMANCE OF MYERS-WHALEY AUTOMATIC SHOVELING MACHINES IN LOADING ROCK AT A PENNSYLVANIA COAL MINE*

Top Rock Shot and Loaded Out at From $.223 to $.35 a Ton—Average Shift Output is 70 1¾-Ton Cars in 11-Foot Entry, Saving at the Rate of $4,920 a Year

SINCE 1924 the Penn Run Coal Corporation, a subsidiary of Peale, Peacock & Kerr, Inc., has used mechanical loaders made by the Myers-Whaley Company for taking top and bottom rock at its mine No. 45 at Clymer, Pa. There is a saving shown of from 21 to 44 percent over hand-loading methods, depending upon the thickness of the rock. Under average conditions the machine effects an annual saving of $4,945, which is a return on the initial investment of 52.4 percent.

The mine was opened in 1923, and the management desired rapid development work. Knowing in advance that there would be considerable rock work, it was decided to use mechanical means for loading and the first Myers-Whaley shoveling machine was installed soon after the mine was opened.

Working Methods with the Shovel

Entries are developed 11 ft. wide and to a height of 6 ft. above the rails. The coal is the "B" or Miller seam, with an average thickness of 42 in., and is clean except for a 4-in. band of bone coal against the roof. The latter is chiefly shale, and the bottom is in most cases fire clay. As it is much cheaper to top brush to get the desired head room than to take bottom rock, the bottom is not excavated except in cases where rolls make grading necessary. Even then a comparatively long stretch of top is taken before such grading is attempted.

Coal is first removed for a distance of from 100 to 150 ft. before the loader is brought into the entry to remove top rock. As the head room is low, the tracks for taking coal are laid on the floor with occasional steel ties. Before the machine is brought into the entry this track is raised and permanent ties put under it.

A portable compressor is brought up near the entry to furnish power for rotary drills equipped with 12-ft. steel. Two holes are drilled, one on each rib, and the shots are fired simultaneously. After two or three shots have been fired the drillers have a pile of rock to stand on. This work is carried on far enough ahead of the loader so as not to interfere with its work. The loader, however, is working directly behind the crew doing the shooting.

* Survey made by A. C. Nielsen Company, Engineers, in collaboration with and approved by A. C. Hohnke, Superintendent, Penn Run Coal Corporation, Clymer, Pa.

At times coal is taken far enough ahead to provide a week's work for the shoveling machine, but it has been found most economical to take coal for 100 to 150 ft. before putting the shovel to work. In no case is the shovel taken into an entry for less than two days' work.

No attempt is made to ballast before taking top rock, and the fine rock left after the machine has passed is sufficient for final ballasting, with no need for cleaning up work behind the machine. It might be thought that laying permanent track in this manner without ballast, and shooting from 24 to 36 in. of rock down on it, would cause the rails to spring. This has not been found to be the case—the 30-lb. rails are neither sprung nor bent by the falling rock.

Loading Capacity

To obtain the fullest benefit from the machine it must not be held up waiting for cars to be switched and empty cars are kept as near the machine as possible. Only by keeping empty cars on a near-by siding can rapid development work be accomplished.

Capacity for taking top rock: Under these conditions an average of about 70 cars of 1¾-ton capacity are loaded per day by a crew of five men. Two do the drilling and shooting, the operator and a helper handle the machine, and a fifth man helps in shifting cars on level track or slight grades. On grades so steep that cars can not be pushed by hand a motor is used, and the fifth man is replaced by a motorman.

The record for this mine is 126 1½-ton cars in eight hours. During this run cars were loaded at an average rate of 1½ minutes and were shifted in 2 1/3 minutes.

Capacity for taking bottom rock: In taking bottom rock the shovels have been equally successful, although advance is slower than when operating on permanent track. Track delay is cut to a minimum by using 7-ft. built-up sections of rail, which can be laid in front of the shovel in about 10 minutes.

On this work it is possible to drop the shovel 8 in. below the rail on which it runs. With three men to operate the machine, drill, shoot, shift 1¾-ton cars and lay track, the average loading is about 34 cars in eight hours.

The total removal to date from 11-ft. entries is approximately 17,500 linear yds. of top rock ranging from 24 to 50 in. thick and about 3,200 linear yds. of bottom rock varying in thickness from a few inches to as much as 9 ft.

Hand Method of Loading

The hand method of loading has been used only to determine the cost that it would involve and to determine the saving being effected by the shovels. Only two men can work effectively in an entry when doing hand loading. They can shoot, load and switch from 12 to 14 cars of 1¾-ton type—equivalent to about 24 tons. The machine can load approximately 120 tons in the same time—five times as much. This is a vital factor in the rapid advancement of the mine and is considered more important than the monetary saving.

Power

No attempt has been made to run a long-time check on power consumption, but an engineer of the General Electric Company, who was at the mine investigating other equipment, tested the input and found it to be slightly less than the manufacturer's guarantee when the shovel was operating in heavy rock.

Advantages of Shovel

All parts of the machines are interchangeable, so that the company is able to stock a minimum of spare parts. The true shoveling motion of the machine enables it to handle any kind of material in almost the same manner as a hand shovel. It will take pieces of rock and slate that are much larger than could be loaded by hand, thus avoiding considerable sledging.

The operator's seat is back from the shovel about 10 ft., so that he is at all times protected under the timbered roof.

The general satisfaction afforded by these three shovels is proved by the purchase of three others for service at another mine. These were bought after tests of the first had shown its practicability, low cost and high output.

Summary

Rapid development desired at new mine. Three Myers-Whaley automatic shovels purchased. Of No. 3 model, having capacity of 35 cu. ft. per minute and traveling 70 ft. per minute on mine tracks.

Used in 11-ft. entries in Miller seam, 42-in. thickness. Coal taken for 100 to 150 ft. ahead of shovel. Top rock then taken to give 6 ft. of headroom.

Average day's output is 70 1¾-ton cars, varying with depth of rock removed. Record run is 126 1½-ton cars in eight hours. With 1½ min. for loading and 2 1/3 min. for shifting cars.

Bottom rock taken more slowly, using temporary track sections. Average loading is 34 1¾-ton cars in eight hours.

Daily cost with five men is $38.03. Daily advance in 11-ft. entry averages 19.3 linear yds., at total cost, including powder, of $2.55, or $0.31 per ton.

Advantages over hand loading are: Development speeded up five times, cost reduced 21.4 to 44.6 percent, with daily saving of $19.68, at rate of $4,920 a year, giving net annual return of 52 percent.

TABLE A—COST OF OPERATING MYERS-WHALEY NO. 3 AUTOMATIC SHOVELING MACHINE

Investment:		
First cost		$9,200.00
Freight and assembly cost		260.00
		$9,460.00
Fixed charges:		
Depreciation—10-year life		$946.00
Average interest, at 6 percent		312.00
Maintenance and repairs		175.00
		$1,433.00
Daily cost of operation:		
Daily machine charges — $1,433 ÷ 250 days		$5.73
Power—estimated 10 kw. x 3 hr., at $0.0185		.56
Lubrication—$12 a mo. ÷ 25 days		.48
Total machine costs for 8 hours		$6.77
Labor for 5-man crew (2 men drilling and shooting, 1 machine operator, 1 helper on machine and car moving, 1 helper on cars or 1 motorman), at $6		30.00
Supervision, at $63 per man per year.		1.26
Total daily cost except powder and caps		$38.03

Cost of loading out top rock on 11-ft. entry (average figures for 5-man crew):

Depth (inches)	Daily output Linear yrds.	Cars	Cost per linear yard Machine and labor	Total inc. powder	Cost per ton 1¾-ton car
24	22.5	62	$1.69	$2.13	$0.35
30	20.0	68	1.90	2.48	.32
32 (avg.)	19.3	70	1.97	2.55 (avg.)	.31
36	18.6	77	2.04	2.71	.28
42	18.0	87	2.11	2.88	.25
48	17.7	97	2.15	2.99	.223

TABLE B—SAVINGS EFFECTED BY MYERS-WHALEY SHOVELING MACHINE OVER TAKING TOP ROCK BY HAND

Comparative costs and differentials:

Thickness (inches)	Total per linear yard Machine	Hand	Saving by machine Dollar per yard	Percent
24	$2.13	$2.71	$0.58	21.4
30	2.48	3.38	.90	26.6
32	2.55	3.57	1.02	28.6
36	2.71	4.05	1.34	33.1
42	2.88	4.73	1.85	39.1
48	2.99	5.40	2.41	44.6

Savings by machine:

Per day in average rock thickness of 32 inches—$1.02 x 19.3 yd. advance per day	$19.68
Per year at above average rate—$19.68 x 250 days	$4,920.00
Net annual return on investment	Percent.. 52

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

ACETYLENE GAS
Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AFTERCOOLERS (Air)
Ingersoll-Rand Co., New York City.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

AIR COMPRESSOR OILS
Standard Oil Co. (Ind.), Chicago, Ill.

AIR FILTERS—Bag type
American Coal Cleaning Corpn., Welch, W. Va.

AIR HEATERS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AIR LIFT PUMPING
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

ANNUNCIATOR WIRES & CABLES
John A. Roebling's Sons Co., Trenton, N. J.

ANNUNCIATOR WIRES & CABLES, INSULATED
American Steel & Wire Co., Chicago, Ill., and New York.

ANTI-RUST OILS & GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

ARMATURE COILS & LEADS
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ARMORGRIDS
Hendrick Mfg. Co., Carbondale, Pa.
General Electric Co., Schenectady, N. Y.

ASPIRATORS
American Coal Cleaning Corpn., Welch, W. Va.

AUTOMATIC CAR & CAGER STOPS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

AUTOMATIC CAR DUMPERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

AUTOMATIC FLAGGING SIGNALS
American Mine Door Co., Canton, Ohio.

AUTOMATIC (Mine Doors, Trucks and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC MINE SWITCHES
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AUTOMATIC SWITCH THROWERS
American Mine Door Co., Canton, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AUTOMOBILE CABLES
John A. Roebling's Sons Co., Trenton, N. J.

BAG TYPE AIR FILTERS
American Coal Cleaning Corpn., Welch, W. Va.

BALLAST UNLOADER ROPES
John A. Roebling's Sons Co., Trenton, N. J.

BALL BEARINGS
S K F Industries, 40 E. 34th St., New York City.

BALL & ROLLER BEARINGS
S K F Industries, 40 E. 34th St., New York City.

BARS, STEEL
Carnegie Steel Co., Pittsburgh, Pa.
Timken Roller Bearing Co., Canton, Ohio.

BATTERIES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

BATTERIES, Armature
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BATTERIES, Blasting
Hercules Powder Co., Wilmington, Del.

BATTERIES, DRY (for Bells, Buzzers, Signals, Blasting)
National Carbon Co., Inc., 30 East 42nd St., New York City.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42d St., New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BEARINGS
S K F Industries, 40 E. 34th St., New York City.

BEARINGS (for all kinds of equipment)
Hyatt Roller Bearing Co., Newark, N. J.

BEARINGS, ANGULAR CONTACT
S K F Industries, New York City.

BEARINGS, ANTI-FRICTION
S K F Industries, New York City.

BEARINGS, ARMATURE
S K F Industries, New York City.

BEARINGS, AUTOMATIC
S K F Industries, New York City.

BEARINGS, BALL
S K F Industries, New York City.

BEARINGS, JOURNAL, CAR & LOCOMOTIVE
S K F Industries, New York City.

BEARINGS, MOTOR, ELECTRIC
S K F Industries, New York City.

BEARINGS RADIAL
Timken Roller Bearing Co., Canton, Ohio.
S K F Industries, New York City.

BEARINGS, ROLLER
S K F Industries, New York City.

BEARINGS, SHAFT, SELF-OILING
S K F Industries, New York City.

BEARINGS, TAPERED ROLLER
Timken Roller Bearing Co., Canton, Ohio.

BEARINGS, THRUST
S K F Industries, New York City.
Timken Roller Bearing Co., Canton, Ohio.

BELL CORD
John A. Roebling's Sons Co., Trenton, N. J.

BELT DRESSING
Standard Oil Co. (Ind.), Chicago, Ill.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BITS, Carbon (Diamonds) for Core Drill
R. S. Patrick, Sellwood Building, Duluth, Minn.
Diamond Drill Carbon Co., World Bldg., New York.

BITS, Diamond Drilling
R. S. Patrick, Sellwood Building, Duluth, Minn.

BIT SHARPENERS
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLACK OILS
Standard Oil Co. (Ind.), Chicago, Ill.

BLASTING ACCESSORIES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

BLASTING CAPS
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

BLASTING MACHINES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

BLASTING POWDER
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING UNITS (Dry Battery)
National Carbon Co., Inc., 30 East 42nd St., New York City.

BLOCKS, PILLOW
S K F Industries, New York City.

BLOWERS, CENTRIFUGAL
American Coal Cleaning Corpn., Welch, W. Va.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BLOWERS (or Compressors)
General Electric Co., Schenectady, N. Y.

BLOWERS (Tubing)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.

BLOWERS (Turbine)
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42d St., New York City.

BLUE CENTER STEEL WIRE ROPE
John A. Roebling's Sons Co., Trenton, N. J.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

BOND TERMINALS
American Mine Door Co., Canton, Ohio.

BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.
Diamond Drill Carbon Co., World Bldg., New York.

BRACES GAUGE
Central Frog & Switch Co., Cincinnati, Ohio.

BRACES, RAIL
Central Frog & Switch Co., Cincinnati, Ohio.

BRACES, TRACK
Central Frog & Switch Co., Cincinnati, Ohio.

BRAZILIAN ROCK CRYSTAL
Diamond Drill Carbon Co., World Bldg., New York.

BREAKER MACHINERY
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

BREAKERS
American Coal Cleaning Corpn., Welch, W. Va.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BREAST MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

BRIQUETTING MACHINERY
Vulcan Iron Works, Wilkes-Barre, Pa.

BRUSHES (Carbon, Graphite and Metal Graphite for Electric Motors, Generators and Converters)
National Carbon Co., Inc., Cleveland, Ohio, and San Francisco, Calif.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BUCKETS (Elevator)
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CABLE COMPOUNDS
Standard Oil Co. (Ind.), Chicago, Ill.

CABLE GREASE
Keystone Lubricating Co., Philadelphia, Pa.

CABLES
American Steel & Wire Co., Chicago and New York.
Roebling's Sons Co., John A., Trenton, N. J.
Ohio.

CABLES (Connectors and Guides)
American Mine Door Co., Canton,

CABLES, INSULATED
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

CABLES, SUSPENSION BRIDGE
John A. Roebling's Sons Co., Trenton, N. J.

CABLEWAYS
American Steel & Wire Co., Chicago, Ill., and New York.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CAGE DUMPERS, ROTARY
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CAGES (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGE STOPS & LOCKS
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co. Chicago, Ill.

CAGERS, AUTOMATIC
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAGERS, AUTOMATIC & MANUAL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CAGES (Self-dumping)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CALCINERS
Vulcan Iron Works, Wilkes-Barre, Pa.

CALCIUM CARBIDE
Union Carbide Sales Co., 30 East 42nd St., New York City.

CARBON AND BORTZ
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON FOR DIAMOND DRILLING
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

CARBON BURNING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CARBON ELECTRODES (for Electric Furnaces and Electrolytic Work)
National Carbon Co., Inc., Electrode Sales Division, 30 East 42nd St., New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CARBONS (for Arc Lamps, Blue Printing, Photographic)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

CARBON SPECIALTIES (Circuit Breaker Contacts, Packing Rings, Filter Plates, Tubes, etc.)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

CAR DUMPERS, GRAVITY & POWER
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR DUMPERS (Rotary)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR FEEDERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CAR HAULS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CARNOTITE ORES
O. Barlow Willmarth, Georgetown, Colo.

CAR PULLERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CAR RETARDERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CARS OF ALL DESCRIPTION
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

CAR STOPS, AUTOMATIC & MANUAL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR WIRE & CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CASTINGS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Timken Roller Bearing Co., Canton, Ohio.

CASTINGS, GRAY IRON
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS, OPEN HEARTH STEEL
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS (steel, iron)
Vulcan Iron Works, Wilkes-Barre, Pa.

CAST STEEL FROGS
Central Frog & Switch Co., Cincinnati, Ohio.

CHAINS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CHAINS, DRIVE
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAIN LUBRICANTS
Standard Oil Co. (Ind.), Chicago, Ill.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, Silent (Bushed-Pin Joint)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CIRCUIT-BREAKERS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, GUARD RAIL
Central Frog & Switch Co., Cincinnati, Ohio.

CLAMPS (Mine)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CLIPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CLOTH, WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CLEANING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
American Rheolaveur Corporation, Wilkes-Barre, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL COMPANIES
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.

COAL CONVEYING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS & ROLLS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COAL LOADERS
Conveyor Sales Co., 299 Broadway New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COAL MINING PLANTS
American Coal Cleaning Corpn., Welch, W. Va.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL PREPARATION MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL SEPARATING MACHINERY
W. S. Tyler Co., Cleveland, Ohio.

COAL SEPARATORS (Pneumatic)
American Coal Cleaning Corpn., Welch, W. Va.
Roberts & Schaefer Co., Chicago, Ill.

COAL SEPARATORS (Spiralizers)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL TESTING EQUIPMENT
W. S. Tyler Co., Cleveland, Ohio.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago, Ill., and New York.

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONTROLLERS
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVERTERS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVEYORS
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CONVEYOR BEARINGS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, COAL
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, PAN OR APRON
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COOLERS, Man
Robinson Ventilating Co., Zelienople, Pa.

COOLERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

COPPER WIRE & STRAND (Bare)
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CORE DRILLS, Carbon (Diamonds) for
R. S. Patrick, Sellwood Building, Duluth, Minn.

CORE DRILLING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Pennsylvania Drilling Co., Pittsburgh, Pa.

COUPLINGS, FLEXIBLE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

CRUSHER OILS
Standard Oil Co. (Ind.), Chicago, Ill.

CRUSHERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Symons Bros. Co., Chicago, Ill.

CRUSHERS, Coal
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CRUSHERS, SINGLE & DOUBLE ROLL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRYSTAL (Quartz)
Diamond Drill Carbon Co., World Bldg., New York.

CUP GREASE
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42d St., New York City.

CYCLONE DUST COLLECTORS
American Coal Cleaning Corpn., Welch, W. Va.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

DESIGNERS OF PLANTS
American Coal Cleaning Corpn., Welch, W. Va.
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DETONATORS
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

DIAMOND CORE DRILL CONTRACTING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DIAMOND DRILLING CARBON
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, INDUSTRIAL
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMOND TOOLS
Diamond Drill Carbon Co., World Bldg., New York.

DIESEL ENGINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

DIGGERS & PICKS, Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILLERS' DIAMONDS
Diamond Drill Carbon Co., World Bldg., New York.

DRILLING CONTRACTORS
Pennsylvania Drilling Co., Pittsburgh, Pa.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILLING, DIAMONDS FOR
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILL BITS, Carbon (Diamonds) for
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL, CARBON (Diamonds) for
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL COLUMNS & MOUNTINGS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILL LUBRICANTS
Standard Oil Co. (Ind.), Chicago, Ill.

DRILLER'S DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, CORE
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRILLS (Hand Operated Coal)
Ohio Brass Co., Mansfield, Ohio.

DRILLS, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, ROCK
Diamond Machine Co., Monongahela, Pa.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRIVES, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

DRY CLEANING COAL & COKE
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DRYERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

DUMP CARS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

DUMPS (Rotary, Cradle, Crossover & Kickback)
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co., Chicago, Ill. Pittsburgh, Pa.

DUST COLLECTING EQUIPMENT
American Coal Cleaning Corpn., Welch, W. Va.

DUST FILTERS
American Coal Cleaning Corpn., Welch, W. Va.

DYNAMITE
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

DYNAMOS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

DYNAMO OILS
Standard Oil Co. (Ind.), Chicago, Ill.

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRICAL CABLES & WIRES
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.

ELECTRIC BLASTING CAPS
Hercules Powder Co., Wilmington, Del.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRIC LOCOMOTIVE CABLES
John A. Roebling's Sons Co., Trenton, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRIC MINE SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRIC WIRES AND CABLES
General Electric Co., Schenectady, N. Y.
American Steel & Wire Co., Chicago, Ill., and New York.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRICAL WIRES AND CABLES
John A. Roebling's Sons Co., Trenton, N. J.

ELECTRODES, WELDING
John A. Roebling's Sons Co., Trenton, N. J.

ELEVATORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.

ELEVATORS, BUCKET
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ELEVATOR CABLES & ROPES
John A. Roebling's Sons Co., Trenton, N. J.

ELEVATOR AND HOIST MOTORS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELEVATOR MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ENGINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ENGINES, OIL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

EXCAVATORS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

EXHAUSTERS
American Coal Cleaning Corpn., Welch, W. Va.

EXPLOSIVES
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St. Wilmington, Del.

FAN DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS, Man Cooling
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS, Turbine
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FEEDERS
Hockensmith Wheel & Mine Car Co., Penn, Pa.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

FEEDERS (Gravity)
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.

FEEDERS (Hand Operated)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

FEEDERS, ORE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

FEEDERS (Reciprocating)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

American Coal Cleaning Corpn., Welch, W. Va.

FEEDERS (Semi-automatic)
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

FENCE POSTS
Sweet's Steel Co., Williamsport, Pa.

FIBRE GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

FILTER CLOTH, WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

FILTERS (Dust)
American Coal Cleaning Corpn., Welch, W. Va.

FIRE AND WEATHER-PROOF WIRE
John A. Roebling's Sons Co., Trenton, N. J.

FLASHLIGHTS AND BATTERIES (Mine Safety)
National Carbon Co., Inc., 30 East 42d Street, New York City.

FLOORING, OPEN STEEL
Hendrick Mfg. Co., Carbondale, Pa.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FLOTATION OILS
Hercules Powder Co., 934 King St., Wilmington, Del.

FLOW METERS
General Electric Co., Schenectady, N. Y.

FLUX, WELDING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

FORGINGS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FROGS
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

FROGS AND SWITCHES
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

FURNACE OIL
Standard Oil Co. (Ind.), Chicago, Ill.

FURNACES, Oil (for drill steel)
Ingersoll-Rand Co., 11 Broadway, New York City.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

GAS (Nitrogen, Oxygen)
Linde Air Products Co., 30 E. 42d St., New York City.

GASOLINE
Standard Oil Co. (Ind.), Chicago, Ill.

GAS ENGINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

GAUGES, WELDING & CUTTING
Central Frog & Switch Co., Cincinnati, Ohio.

GAUGE RODS
Central Frog & Switch Co., Cincinnati, Ohio.

GAUGES, WELDING & CUTTING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GEAR COMPOUNDS
Standard Oil Co. (Ind.), Chicago, Ill.

GEARS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS, BEVEL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS (Fabroil & Textelite)
General Electric Co., Schenectady, N. Y.

GEARS, HERRINGBONE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Machine Cut
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Moulded Tooth
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Silent Chain
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

GEARS, SPUR
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, WORM
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GELATIN DYNAMITES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GENERATORS, ACETYLENE
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GLOVES, ASBESTOS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GRAPHITE GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

GRATING, AREA, SIDE WALK
Hendrick Mfg. Co., Carbondale, Pa.

GREASE
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

GRINDERS, Portable Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

GUARD RAIL CLAMPS
Central Frog & Switch Co., Cincinnati, Ohio.

GUY ROPES, GALVANIZED
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

HAMMERS, Calking, Chipping & Riveting
Ingersoll-Rand Co., 11 Broadway, New York City.

HANGERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, 40 E. 34th St., New York City.

HANGERS (Insulated Trolley)
Ohio Brass Co., Mansfield, Ohio.

HANGERS, Ball Bearing
S K F Industries, New York City.

HANGERS, SHAFT, DROP
S K F Industries, New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

HANGERS, SHAFT, POST
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, New York City.

HANGERS, SHAFT, SELF-OILING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, New York City.

HAULAGE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

HEADLIGHTS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

HEATER CORD
John A. Roebling's Sons Co., Trenton, N. J.

HERRINGBONE GEAR DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

HIGH EXPLOSIVES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

HOIST DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTING ROPES
American Steel & Wire Co., Chicago, Ill., and New York.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
John A. Roebling's Sons Co., Trenton, N. J.

HOISTS
American Steel & Wire Co., Chicago, Ill., and New York.
Ingersoll-Rand Co., 11 Broadway, New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, AIR
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTS, PORTABLE
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, Room
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTS, Room and Gathering
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

HOISTS, Scraper-Loader
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

HOISTS, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOLDERS-ON RIVETING
Ingersoll-Rand Co., 11 Broadway, New York City.

HOOKS
John A. Roebling's Sons Co., Trenton, N. J.

HOSE, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

HOSE, WELDING AND CUTTING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

HYDRATORS, LIME
Vulcan Iron Works, Wilkes-Barre, Pa.

IGNITERS, Electric
Hercules Powder Co., Wilmington, Del.

INCINERATORS
Vulcan Iron Works, Wilkes-Barre, Pa.

INCLINE FROGS
Central Frog & Switch Co., Cincinnati, Ohio.

INCLINE TRACK LAYOUTS
Central Frog & Switch Co., Cincinnati, Ohio.

INSULATORS, FEEDER WIRE
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATORS, SECTION
Amer. Mine Door Co., Canton, Ohio.
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATORS (Porcelain)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATORS (Third Rail)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATED WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
John A. Roebling Sons Co., Trenton, N. J.

KEROSENE
Standard Oil Co. (Ind.), Chicago, Ill.

KILNS (Rotary)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Vulcan Iron Works, Wilkes-Barre, Pa.

KILNS, VERTICAL
Vulcan Iron Works, Wilkes-Barre, Pa.

LAMP CORD
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

LAMPS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co., 30 E. 42d St., New York City.

LIGHT AND POWER PLANTS (Small)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LIGHT STEEL ANGLES
Sweet's Steel Co., Williamsport, Pa.
Carnegie Steel Co., Pittsburgh, Pa.

LIGHT STEEL RAILS
Carnegie Steel Co., Pittsburgh, Pa.
West Virginia Rail Co., Huntington, W. Va.

LIGHT STEEL RAILS (A. S. C. E. Sections)
Sweet's Steel Co., Williamsport, Pa.

LINE SHAFT
S K F Industries, 40 E. 34th St., New York City.

LOADERS, Gravel and Sand
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS (Mine Car)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Myers-Whaley Co., Knoxville, Tenn.

LOADERS, PORTABLE
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Myers-Whaley Co., Knoxville, Tenn.

LOADERS, Snow
Joy Manufacturing Co., Franklin Pa.

LOADERS, Truck
Joy Manufacturing Co., Franklin Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS, Wagon
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Conveyor Sales Co., 299 Broadway, New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Myers-Whaley Co., Knoxville, Tenn.

LOCOMOTIVES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVES, GASOLINE
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVES, RACK RAIL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

LOCOMOTIVES, STEAM
Vulcan Iron Works, Wilkes-Barre, Pa.

LOCOMOTIVES, STORAGE BATTERY
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVE SWITCHING & WRECKING ROPES
John A. Roebling's Sons Co., Trenton, N. J.

LOCOMOTIVES (Third Rail)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

LOCOMOTIVES, TROLLEY
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LONGWALL MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

LUBRICANTS
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

LUBRICATORS
Keystone Lubricating Co., Philadelphia, Pa.

MACHINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

MACHINERY, TRANSMISSION (Power)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y..

MANIFOLDS, OXYGEN
Oxweld Acetylene Co., 30 E. 42d St., New York City.

MAST ARM ROPE, Galvanized
John A. Roebling's Sons Co., Trenton, N. J.

MILL GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

MILLS, ROD & BALL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MILLS, STAMPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINE CAR AXLES
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE CAR BEARINGS
Hyatt Roller Bearing Co., Newark, N. J.
Timken Roller Bearing Co., Canton, Ohio.

MINE CAR BOXES
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE CAR FORGINGS
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE CAR LUBRICANTS
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

MINE CAR PARTS
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

MINE CAR ROLLER BEARINGS
American Car & Foundry Co., 30 Church St., New York City.

MINE CARS
American Car & Foundry Co., 30 Church St., New York City.
Enterprise Wheel & Car Corporation, Huntington, W. Va.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

MINE CAR WHEELS
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE DOORS, AUTOMATIC
American Mine Door Co., Canton, Ohio.

MINE LOCOMOTIVE CABLE
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

MINE TIES
Central Frog & Switch Co., Cincinnati, Ohio.

MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING MACHINE CABLE
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

MINING MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

MINING MACHINES (Electric)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING MACHINES (Government Approved)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING MACHINERY BEARINGS
Hyatt Roller Bearing Co., Newark, N. J.

MOTOR OILS
Standard Oil Co. (Ind.), Chicago, Ill.

MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS, Electric
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOUNTED BOTTOM CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

MOVING PICTURE CORD
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

NITROGEN GAS
Linde Air Products Co., 30 East 42d St., New York City.

OILS
Standard Oil Co. (Ind.), Chicago, Ill.

ORE, BUYERS AND SELLERS OF
Irvington Smelting & Refining Works, Irvington, N. J.

ORE, CARNOTITE & VANADIUM
O. Barlow Willmarth, Georgetown, Colo.

OVERCUTTING MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

OXYGEN GAS
Linde Air Products Co., 30 East 42d St., New York City.

OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co., 30 E. 42d St., New York City.

PAVING BREAKERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

PERFORATED METAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

PERMISSIBLES, Explosives
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

PETROLATUMS
Standard Oil Co. (Ind.), Chicago, Ill.

PICKING TABLES
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

PIPE (Genuine Wrought Iron)
A. M. Byers Co., Pittsburgh, Pa.

PIPE (Wood)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PNEUMATIC COAL SEPARATING MACHINERY
American Coal Cleaning Corp., Welch, W. Va.

PNEUMATIC SIZING MACHINERY
American Coal Cleaning Corp., Welch, W. Va.

PNEUMATIC TOOL
Ingersoll-Rand Co., 11 Broadway, New York City.

PNEUMATIC TOOL LUBRICANT
Standard Oil Co. (Ind.), Chicago, Ill.

PORTABLE TRACK
Central Frog & Switch Co., Cincinnati, Ohio.

PORTABLE TURNOUTS
Central Frog & Switch Co., Cincinnati, Ohio.

POWDER BLASTING
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

POWER CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

POWER SHOVELS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PREHEATING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

PRESSURE GUN GREASE
Standard Oil Co. (Ind.), Chicago, Ill.

PROSPECTIVE DRILLS
Hoffman Bros. Drilling Co., Punxsatawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Pennsylvania Drilling Co., Pittsburgh, Pa.

PULLEYS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

PULLEYS, BALL OR ROLLER BEARING
S K F Industries, New York City

PULLEYS, CLUTCH, FRICTION
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, New York City.

PULLEYS, LOOSE
S K F Industries, New York City.

PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

PUMPS, Acid Resisting
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

PUMPS, Boiler Feed
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, DEEP WELL
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS (Electric)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PUMPS, Fire
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PUMPS, Inclined Shaft
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, MINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, Sinking
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, POWER
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, VACUUM
Ingersoll-Rand Co., 11 Broadway, New York City.

PUNCHES, Drill Steel
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

QUARRYING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

QUARTZ CRYSTAL
Diamond Drill Carbon Co., World Bldg., New York.

RADIO ACTIVE ORE
O. Barlow Willmarth, Georgetown, Colo.

RADIUM ORE
O. Barlow Willmarth, Georgetown, Colo.

RAIL BONDS
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

RAIL BRACES
Central Frog & Switch Co., Cincinnati, Ohio.

RAILWAY SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

RAMMERS, Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

RECEIVERS, AIR
Ingersoll-Rand Co., 11 Broadway, New York City.

REGULATORS, Welding and Cutting, Compressed Gas
Oxweld Acetylene Co., 30 E. 42d St., New York City.

REHEATERS, Air
Ingersoll-Rand Co., 11 Broadway, New York City.

REINFORCING BARS
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

RESCUE APPARATUS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

RETARDERS
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

RIVER CROSSING SUSPENSION WIRE, Galvanized
John A. Roebling's Sons Co., Trenton, N. J.

ROCK-DISPOSAL EQUIPMENT
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

ROCK DRILLS
Ingersoll-Rand Co., 11 Broadway, New York City.

ROCK DUSTING EQUIPMENT
American Mine Door Co., Canton, Ohio.

RODS, WELDING
Ohio Brass Co., Mansfield, Ohio.
Oxweld Acetylene Co., 30 E. 42d St., New York City.

ROLLER BEARINGS
Enterprise Wheel & Car Corporation, Huntington, W. Va.
Hyatt Roller Bearing Co., Newark, N. J.
Timken Roller Bearing Co., Canton, Ohio.

ROLLS (Crushing)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ROPE
American Steel & Wire Co., Chicago, Ill., and New York.

ROPE GREASE
Keystone Lubricating Co., Philadelphia, Pa.

ROPE, TRANSMISSION
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

ROPE, WIRE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

ROTARY DRYERS
Vulcan Iron Works, Wilkes-Barre, Pa.

ROTARY COOLERS
Vulcan Iron Works, Wilkes-Barre, Pa.

ROTARY DUMPS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

ROTARY ROASTERS
Vulcan Iron Works, Wilkes-Barre, Pa.

RUNNING ROPE, Galvanized
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

SAFETY FUSE
Hercules Powder Co., Wilmington, Del.

SAFETY FUSE & WIRES—LEADING & CONNECTING
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

SAND DRYERS
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SASH CORD
John A. Roebling's Sons Co., Trenton, N. J.

SAWS (Air)
Ingersoll-Rand Co., 11 Broadway, New York City.

SCRAPER LOADERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

SCREEN BARS
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

SCREENS (Anti-Gravity)
American Coal Cleaning Corpn., Welch, W. Va.

SCREENS, ARCH-CRIMP
Ludlow Saylor Wire Co., St. Louis, Mo.

SCREENS, DOUBLE CRIMPED
Ludlow Saylor Wire Co., St. Louis, Mo.

SCREENS, HORIZONTAL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
W. S. Tyler Co., Cleveland, Ohio.

SCREENS, PERFORATED METAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS, REK-TANG
Ludlow Saylor Wire Co., St. Louis, Mo.

SCREENS, REVOLVING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS, SHAKER
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

SCREENS (Vibrating)
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
W. S. Tyler Company, Cleveland, Ohio

SCREENS & WASHERIES
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SCREENS, WOVEN WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

SEIZING STRAND, GALVANIZED
John A. Roebling's Sons Co., Trenton, N. J.

SHARPENERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

SHEAVES
Hockensmith Wheel & Mine Car Co., Penn, Pa.
John A. Roebling's Sons Co., Trenton, N. J.
Vulcan Iron Works, Wilkes-Barre, Pa.

SHEAVE WHEELS
Hockensmith Wheel & Mine Car Co., Penn, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

SHORTWALL MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Hyatt Roller Bearing Co., Newark, N. J.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

SHOVELS, ELECTRIC
Myers-Whaley Co., Knoxville, Tenn.

SHOVEL—ELECTRO-HYDRAULIC
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

SIGNAL WIRES AND CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

SIGNS (Mine)
Stonehouse Signs, Inc., 842 Larimer St., Denver, Colo.

SINKERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

SKIPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

SKIP LOADING EQUIPMENT
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SLABBING MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

SMELTERS
Irvington Smelting & Refining Works, Irvington, N. J.

SOCKETS, Open and Closed
John A. Roebling's Sons Co., Trenton, N. J.

SPECIAL MACHINERY
Vulcan Iron Works, Wilkes-Barre, Pa.

SPEED REDUCERS, DOUBLE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPEED REDUCERS, SINGLE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPIKES
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

SPLICE BARS (Plain and Angle)
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

SPLICE, CABLE
American Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.

SPLICE, INSULATOR
American Mine Door Co., Canton, Ohio.

SPLICE, TROLLEY WIRE
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

SPLICERS, TROLLEY
American Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SPROCKETS, CLAMP HUB
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, COMPENSATING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS (Shearing Pin)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, SPRING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPUR GEAR DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

STARTER CABLES
John A. Roebling's Sons Co., Trenton, N. J.

STEAM CYLINDER OILS
Standard Oil Co. (Ind.), Chicago, Ill.

STEEL, ALLOY
Timken Roller Bearing Co., Canton, Ohio.

STEEL CROSS TIES
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

STEEL, ELECTRIC FURNACE
Timken Roller Bearing Co., Canton, Ohio.

STEEL, HOLLOW AND SOLID DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

STEEL, NICKEL
Timken Roller Bearing Co., Canton, Ohio.

STEEL, NICKEL, MOLYBDENUM
Timken Roller Bearing Co., Canton, Ohio.

STEEL, OPEN HEARTH
Timken Roller Bearing Co., Canton, Ohio.

STEEL, REINFORCING
American Mine Door Co., Canton, Ohio.

STEEL, SHAPES, PLATES, BARS, ETC.
Carnegie Steel Co., Pittsburgh, Pa.

STEEL, Special Analysis
Timken Roller Bearing Co., Canton, Ohio.

STEEL TIES AND REINFORCEMENTS
Carnegie Steel Co., Pittsburgh, Pa.
West Virginia Rail Co., Huntington, W. Va.

STEPS, SAFETY STAIR AND LADDER
Hendrick Mfg. Co., Carbondale, Pa.

STOPERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

STORAGE BATTERY LOCOMOTIVES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

STRAND
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

SWITCHBOARD WIRE AND CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SWITCHES
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

SWITCHES, ALTERNATING
Mining Safety Device Co., Bowerston, Ohio.

SWITCHES (Disconnecting and Electric)
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SWITCHES AND FROGS, TROLLEY
American Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TACKLE BLOCKS
John A. Roebling's Sons Co., Trenton, N. J.

TANKS
Hendrick Mfg. Co., Carbondale, Pa.

TELEGRAPH AND TELEPHONE WIRES AND CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

TELEPHONE CORDS
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

THIMBLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

TIES (Steel, Mine)
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.

TIES, WOOD TREATED
Curtin-Howe Corpn., 11 Park Place, New York City.

TILLER ROPE
John A. Roebling's Sons Co., Trenton, N. J.

TIMBER PRESERVING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Curtin-Howe Corpn., 11 Park Place, New York City.

TIMBERS, STEEL MINE
Carnegie Steel Co., Pittsburgh, Pa.

TIMBERS, WOOD TREATED
Curtin-Howe Corpn., 11 Park Place, New York City.

TIPPLES
American Coal Cleaning Corp., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

TIPPLE EQUIPMENT
American Coal Cleaning Corp., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

TIPPLE TRACK
Central Frog & Switch Co., Cincinnati, Ohio.

TIRE WIRES
John A. Roebling's Sons Co., Trenton, N. J.

TOOLS, Blacksmiths (for drill steel)
Ingersoll-Rand Co., 11 Broadway, New York City.

TORCHES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42d St., New York City

TRACK BOLTS
Sweet's Steel Co., Williamsport, Pa.

TRACK EQUIPMENT
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

TRACK LAYOUTS (Industrial)
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

TRACKS, PORTABLE, RAIL, ETC.
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK (Portable)
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

TRACK (Portable, Assembled and Unassembled, Riveted or Bolted)
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK BRACES
Central Frog & Switch Co., Cincinnati, Ohio.

TRACK SUPPLIES
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRAMWAYS, AERIAL
American Steel & Wire Co., Chicago, Ill., and New York.

TRANSFORMER OILS
Standard Oil Co. (Ind.), Chicago, Ill.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TRANSMISSION
S K F Industries, 40 E. 34th St., New York City.

TRANSMISSION OILS AND GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

TRANSMISSION, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

TREADS, SAFETY STAIR AND LADDER
Hendrick Mfg. Co., Carbondale, Pa.

TROLLEY FROGS
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TROLLEY (Hangers and Clamps)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TROLLEY MATERIAL, OVERHEAD
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TROLLEY WHEELS AND HARPS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TROLLEY WIRE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

TRUCKS, WELDER'S
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TURBINE BLOWERS
Robinson Ventilating Co., Zelienople, Pa.

TURBINES, HYDRAULIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Standard Oil Co. (Ind.), Chicago, Ill.

TURBINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TURNBUCKLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

TURNOUTS
Sweet's Steel Co., Williamsport, Pa.

VALVES
Ohio Brass Co., Mansfield, Ohio.

VALVES, Back Pressure, Pressure Reducing
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

VANADIUM ORE
O. Barlow Willmarth, Georgetown, Ohio.

VENTILATING EQUIPMENT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

VISES, Riggers
John A. Roebling's Sons Co., Trenton, N. J.

WAGON LOADERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

WASHERIES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Coal Cleaning Corp., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

WEIGH BASKETS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

WEIGH HOPPERS
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

WELDING CARBONS (for Electric Arc and Gas Welding Operations)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

WELDING and CUTTING APPARATUS, Etc. (Oxy-Acetylene)
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Standard Oil Co. (Ind.), Chicago, Ill.

INDEX TO ADVERTISERS

Improving Coal Preparation

A Statement By Link-Belt Company

TO make small coal a commercial and paying product has been an ever-increasing problem for the coal operator.

Present-day methods of mining frequently result in coal being brought to the tipple containing 50 percent of "smalls"; that is, coal which is too small to be hand picked; and containing too high a percentage of dirt—often from 20 to 30 percent—to be salable. It is evident that the market value and outlet for such a large proportion of the mine output are most vital factors in the paying or nonpaying capacity of a mining company; in fact, even if there is a ready market for the large-coal output, it may be most difficult to show a profit unless an outlet can be found for the "smalls" at a reasonable selling price.

The ash content of the small coal fixes its selling value. The higher the ash content, the lower the value of the coal; while if the ash approaches 20 percent, the coal is most difficult to dispose of at all. As a rough figure (with the markets becoming more and more critical), if the ash percentage in the "smalls" exceeds 10, then washing should be considered.

A number of coal-washing processes or devices have been developed, based on the separation of the coal from the loose impurities by the differences in their specific gravities when carried in semisuspension by currents of water.

Different means of controlling these currents have been tried, and largely discarded, such as the Elliott "Trough Washer," the Shepherd "Bash Jig" (Fig. 1), and the Draper System, which had an upward spiral current of water inside of a vertical cylindrical tube.

Some of the objectionable features of these were:

(1) Coal had to be screened to individual near sizes, and washed separately. This caused considerable degradation and much dust, and made it necessary to install costly screens and additional coal handling apparatus, with the consequent heavy upkeep of all this extra apparatus.

(2) In the trough washers, the frictional and other resistances grind the edges of coal cubes to dust particles—a thing to be zealously avoided.

(3) A similar happening occurs in the ordinary "bash jig," due to the pounding of material—both coal and dirt—through the entire length of box.

(4) Similarity of movement on the upward and downward strokes of the "Bash" plungers. The downward strokes of plunger lift the mass in the box, but with the upward stroke creating back suction, the whole mass is attracted or drawn down again, before gravity may efficiently function to separate the lighter and heavier parts of the mass.

Consequently, where the specific gravities of coal and dirt are not widely divided, separation is practically impossible, while the amount of good coal attracted through the grids by suction,

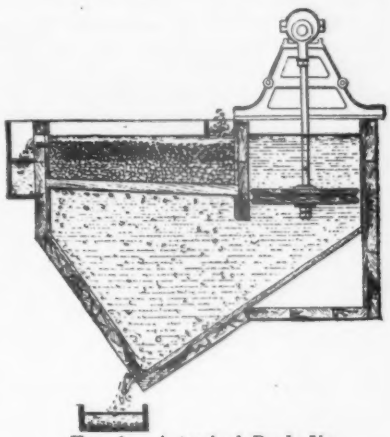

FIG. 1.—*A typical Bash Jig*

and thus lost with the dirt, is of considerable quantity and value.

(5) With each individual size being washed separately, numerous units were required, to gain capacity of any one size, with consequent heavy maintenance, due to the large number of working parts.

All these drawbacks to washing have been eliminated by the Simon-Carves Air Pulsation System, which has taken the place of practically all other devices in the British fields, where a few years ago the problem of securing clean coal was most acute.

This type of washer is now being engineered and built in America by Link-Belt Company, Chicago, and is known as the "Link-Belt-Simon-Carves Washer."

In order to give a clear understanding of the principle and working of the Simon-Carves process, a short description of a direct-acting jig (Fig. 1), commonly used in the past, may not be out of place. This consists of a tank, or box, furnished with a longitudinal vertical division wall. This wall, while not reaching the bottom of the tank, practically divides it into two connecting compartments. On one side of this wall (that is, in one section of the tank), is a plunger which is made to move up and down by means of an eccentric, thus imparting a pulsated motion to the water contained in the tank. On the opposite side of this wall is a fixed horizontal perforated plate or sieve. The raw coal which is fed on to this perforated plate is lifted by the water on the downward stroke of the plunger. On the up stroke of the plunger the water and mass will fall back. It is obvious that lighter particles will be lifted higher as the water is pulsated up, and will fall more slowly than the heavier particles on the return stroke. Given a suitable number of plunger strokes, the material on the sieve will become arranged with the lightest at the top and the heaviest at the bottom.

Shale or dirt has, of course, a higher specific gravity than coal; thus the difference in gravity enables the separation to be effected in the pulsated mass of water.

Necessary inlet and discharge gates are fitted, and a flow of water across the tank introduced, so that raw coal may be fed at one side over a gate, and the light cleaned coal discharged over the opposite gate, while the heavy shale escapes underneath the gate.

This is the bash system of jig washer, of which there were many built in various parts of the world, but very few are now being built.

The greatest of several drawbacks to the bash system is the "back suction" through the bed and the sieve, produced by the upward stroke of the plunger. This suction causes the coal and shale to descend too nearly at equal velocity, and also sucks fine coal through the sieves, with a consequent loss of coal.

The downward, or back suction, is a serious disadvantage in separation; it limits the ratio of sizes which may be washed together, and thus it was necessary to install a number of washing boxes, to deal separately with the individual graduated sizes. This graduation entailed previous screening of the coal. The back suction also limits the range of concentration very seriously, as shown in Fig. 2.

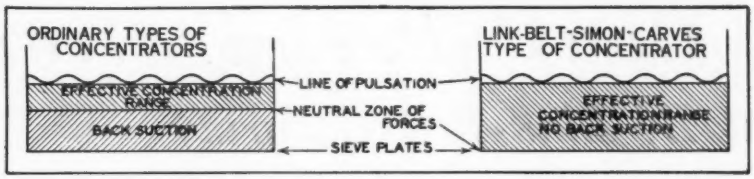

FIG. 2.—*Note particularly the "effective concentration range"*

The diagram (Fig. 2) graphically represents the comparative efficiency of the direct-acting jig with the one about to be described. It will be noted from this that by the introduction of air under pressure, which eliminates back suction, more than twice as much time is given to permit the settling of the refuse.

Dry screening has several objectionable features, and should be avoided where possible.

Among other serious drawbacks to the bash system are the pounding of the material in the box; little or no means of adjustment without stopping the plant; and no adjustment of pulsation without resetting the eccentrics.

All these inconveniences and drawbacks are avoided by using the Link-Belt-Simon-Carves Washer. While the general principle may be similar, the above drawbacks are eliminated by using compressed air as the pulsating medium. This avoids all back suction, and loss of good coal through the bed; allows any necessary adjustment to be made without stopping the plant; discards heavy dirt immediately after it enters the box, thus preventing any possibility of pounding; permits washing of 5" to 0" coal collectively in one box, in capacities of over 100 tons per hour (compared with previous limits of 2½" to 3" maximum size, and 50 tons maximum capacity); cuts out previous dry screening and its attendant dust nuisance; allows graduated pulsations in the different compartments; and the consequent more effective separation; has less wearing and moving parts; furnishes correctly sized coal after washing, without degradation;—and—gives *one man control.*

Figures 3 and 4, representing longitudinal and transverse sections, respectively, of a Link-Belt-Simon-Carves washer box, enable one to follow clearly the principle of separation, and flow of coal and dirt, after entering the box in massed condition. The washer box is divided longitudinally into two main sections, and transversely into a suitable number of smaller sections or compartments (generally from 4 to 6), according to the class and quantity of coal to be handled. Box shell and all division walls are constructed of heavy mild steel plates, built up on suitable steel angle frames, the whole securely riveted together to form a substantial watertight tank. On one side of the longitudinal wall or division plate, suitable adjustable channels are arranged for supporting the sieves or screens, which in turn support the mass product entering the box for washing.

This mass enters from an elevator, conveyor, or other suitable delivering unit, at point marked "Inlet F," and is deposited on sieve at K, compartment 1. Water in suitable volume is admitted to the compartments below bed level, at W1, W2, etc., on air chamber side of division plate; and the fact that it has to pass up through the sieve plate and mass bed (on the other side), prevents all possibility of the bed becoming solid or stagnant.

Pulsation is created by the admission of air at valve C-1. This valve, which is of the ordinary gate type, is set to allow admission of such a quantity of air that it will create a pulsation sufficient to lift all the pure coal and lighter bone coal clear of the sieve plate, leaving the heaviest shale or dirt at the bottom, to move out immediately at adjustable dirt gate G, under the influence of the pulsating water and gravity. This dirt passes down chute H to dirt elevator J, and is discarded.

This is a distinct advantage, as, with this heavy refuse out of the way, the pounding usually attendant on washing in a pulsated box is entirely avoided, for two obvious reasons. (1) The heaviest portion of the mass has left the box without being allowed to fall with, and consequently grind or pound, the softer coals. (2) With this heavy material gone, lighter pulsations are made practicable on the remainder of the course through the box.

During the further passage of material across the various compartments 2, 3 and 4, the pulsations are steadily graduated (through valves C-2, C-3, and C-4) to lighter lifts. Thus, once the purest coal is lifted to the top of the mass, it remains there, and is carried along towards the delivery end of the box N by the water currents, while the heavier of the remaining dirt stays at the bottom. The lighter pulsations at the delivery end (compartment 4) do not disturb the wider range of separation, but function on the nearer or intermediate material, and en-

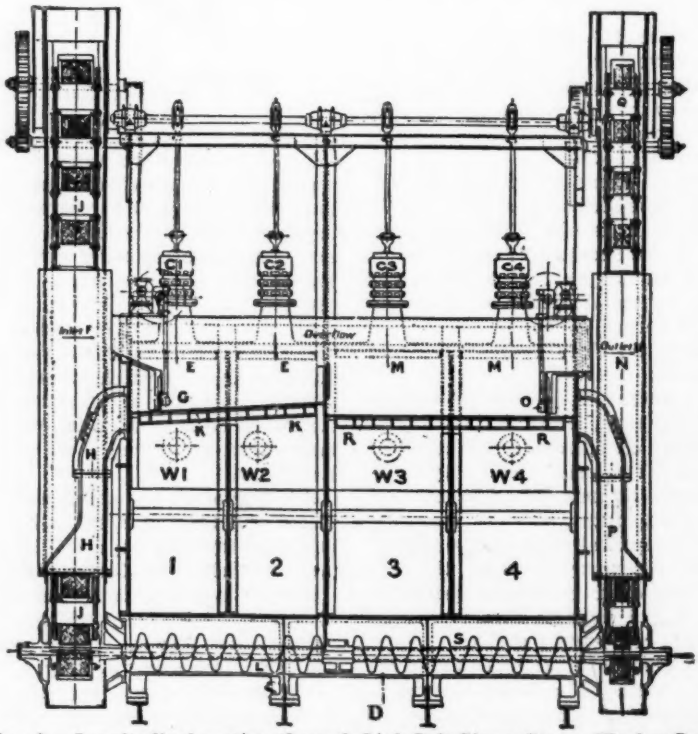

FIG. 3.—*Longitudinal section through Link-Belt-Simon-Carves Washer Box*

able a much more minutely correct result to be arrived at, than in other systems.

In order to demonstrate still more clearly this important point, an example may be quoted. Coal with large heavy shale mixed with light sulphur particles may be entering the box; and to deal with this, No. 1 compartment may be given a pulsation to equal a specific gravity of 1.70, and free the big dirt. Nos. 2, 3 and 4 compartments may be graduated down in suitable ratio to equal a specific gravity of, say, 1.45, and take the fine sulphur out. This variation is not possible on other systems, and is one of the reasons for the outstanding success of this one.

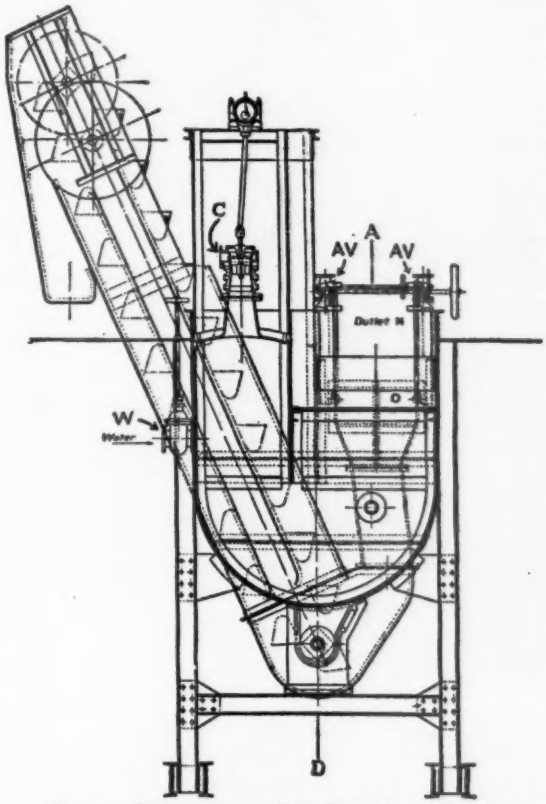

FIG. 4.—*Transverse section through washer box*

The air pulsating medium has other important advantages over the plunger type, apart from its variation range. The water, as before pointed out, enters the box on the air compartment side, and when the air pressure is admitted to the box, the water flow is momentarily—partly—arrested or checked. When the air pressure is released to the atmosphere, leaving only sufficient air in chamber to act as a cushion against the backward fall of the lifted mass, the flow of water again becomes normal under its head of pressure, and also acts as a deterrent to that "bugbear"—back suction, and allows full scope for gravity separation and concentration.

The air valves, which are of hollow piston type, allow the passage of air down the inside, and therefore have no frictional resistance to overcome, and consequently a minimum of wear and tear. As an instance, it only requires ½ horsepower to function the whole valve range. It is *never* necessary—as in other systems—to vary the length of stroke, which is constant in all boxes. Once the inlet valves at C1, C2, etc., are adjusted (and adjustments are made while coal is being washed), there is no occasion to disturb them again, as a single valve control for the whole system is provided for the manipulator. A similar provision takes care of water arrangement after valves W1, W2, etc., are set.

The simple process then to start the plant in daily operation is, switch motors on, to run machinery—open two ordinary hand valves, and start washing. Small particles of dirt passing through the sieve plates are collected in a trough D (which is coupled to base of washer box), and are carried to dirt elevator boot by means of screw conveyor S. The lighter dirt passes out under gate O. Gates G and O are adjustable, and are set up to suit the quantity of dirt being extracted; naturally more lift being required to draw off, say, 15 percent than 10 percent.

It will be noticed by referring to Figure 3 that an air seal is provided on the delivery side of each refuse gate. This insures a steady uniform-push of the refuse off the sieve plates, and entirely prevents spasmodic movement. Atmospheric valves AV (Fig. 4), controlled by cross rod A, are furnished, which enable control to be obtained over the speed of the pushing movement. The control points, few in number, are all close at hand to the operator.

After leaving the washer box at outlet N, the coal has to be sized and dewatered; the coal being delivered to cars or bunkers, as may be arranged, and the water to a pump sump, for recovery and recirculation. It will be readily appreciated that the principle of classifying after washing, rather than before, reduces degradation of the various sizes handled.

The classifying of washed product is performed by passing coal over a flexibly supported perforated metal shaking screen. The smallest size to be loaded out, together with the water, is then carried to a dewatering screen, where it passes over jigging trays fitted with wedge wire screens, which effectually shake the coal free from water, and turn out a moderately dry product. The water is trapped in launders or chutes under these screens, and from thence is diverted to pump sump.

The Link-Belt-Simon-Carves System is a sealed one; in other words, it does not allow loss, and it is at this point that the slurry recovery is made. The recovered water is pumped from the collecting sump by a centrifugal pump to a "Cone Settling Tank" (Fig. 5), where settlement takes place. As the "Dead Fines" reach the bottom of this cone, the material is forced by gravity up the slurry pipe C (Fig. 5) and delivered to the slurry tray mentioned above, and passed back to join the fine coal which is passing over the dewatering screen. With no effluent escaping, no coal is lost, however fine, while the loss of water is only the small quantity carried away by the superficial moisture of coal and refuse. It will be noted that slurry is recovered without moving machinery (which invariably is a costly item).

To give a short description of the Cone Settling Tank in Fig. 5: collected washing water from pump sump is pumped into the tank through the pipe range A, which delivers into the top of cone inside of the cylindrical curtain F. This curtain tends to turn the solids down instead of allowing them to spread, and thus assists in speedy clarification of the washing water. Clear water is taken by pipe range B to the washer box, which has one main valve control. D is an emergency overflow pipe, which comes into use in case of tank becoming too full. Connection E is for cleaning, by flushing, the slurry pipe C, as may be found necessary. Suitable valves are fitted at base of cone for discharge purposes, while a gantry is carried across the top for inspection of tank and fittings.

The foregoing description pertains to an average coal washing problem, where the coal is intended for domestic use, or for the more simple metallurgical requirements. The coal is passed over sizing and dewatering screens direct for shipment, and requires no retreatment.

Where it is necessary to produce an exceptionally clean washed product for

metallurgical purposes, from coal containing a more diversified and an excessive amount of fine impurities, a rewash box is used for retreatment of the very small coal. Here the fines, together with the water, pass from the classifying screens into a sludge sump. At this point, the surplus water overflows into a collecting sump, and the fine coal is removed by an elevator to a rewash box. This machine is of similar construction to the first, but is provided with a wider bed, and the pulsations are much more gentle, so as to efficiently stratify the coal on the bed, and minimized subsequent degradation by the fewer handlings necessary. By virtue of the same set of facts, similar disintegration and scattering of the refuse is also prevented.

Temporary stoppages of this machine do not alter the quality of its products, as an air relief valve can be opened, immediately stopping the action of the washer. Thus, there is no possibility of the bed being washed out of the box through the refuse gates. Moreover, the plant can be started with equal facility, and without variation in results.

4. Minimum consumption of power.
5. Small consumption of water.
6. Inconsiderable liquid effluent.
7. Adequate treatment of fines.
8. Good appearance and sizing of washed products.
9. Minimum breakage.
10. Ability to work satisfactorily under any conditions that may occur at the mines.
11. Low capital outlay.
12. A plant so well constructed upon sound engineering principles that depreciation may be figured over a long period of time; with renewals and replacements seldom necessary.

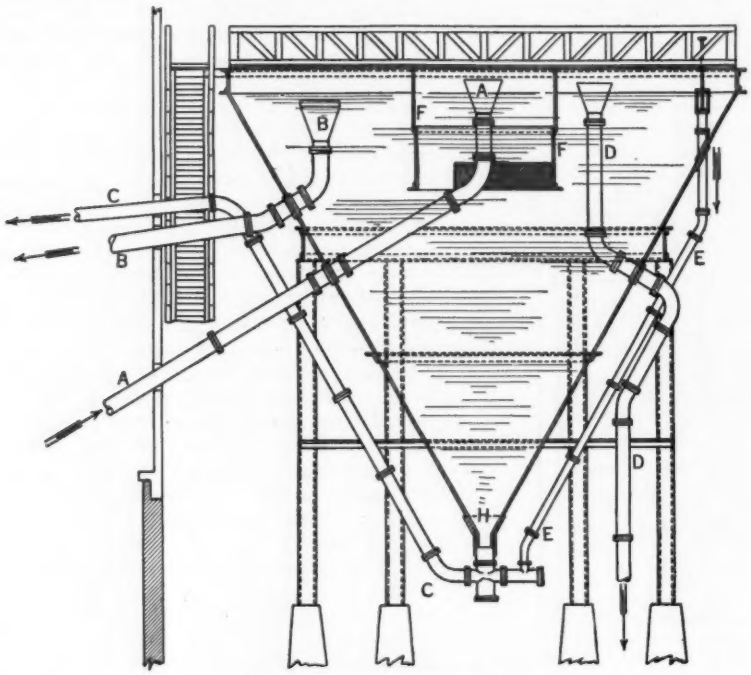

FIG. 5.—*Cone settling tank*

refuse and coal. The coal becomes cleaner as it passes from section to section of the box until discharged.

This brings us to one of the most important points in favor of this system—that is, refuse of a tender nature which would have a tendency to disintegrate shortly after entering the washery and become mixed with the fine coal, is, in this system, immediately rejected with the refuse from the first compartment. It was mentioned before that this type of washer box prevented the grinding of

The entire plant is electrically operated. Great care has been taken to provide easy access to all moving parts, for inspection and lubrication. Building construction may be of concrete, steel, or wood with corrugated siding.

In conclusion it may be well to sum up briefly, what a large experience has shown to be the essential requirements, for a successful coal cleaning plant:

1. Easy supervision and simple adjustment.
2. Cleanest possible coal after treating.
3. Minimum loss of coal in the refuse.

All of these essentials are to be found in the plant just described.

No greater assurance of Link-Belt Company's own faith in the success of these plants can be given than that indicated by giving its name to them.

Just how a washery would help you in enlarging and sustaining your market, would make the subject matter of an interesting discussion between yourself and a Link-Belt engineer.

Address your inquiry direct to our Coal Washery Department.

ARE YOU HEATING THE SKY-

See pages 172-181 inclusive, Keystone Coal Mining Catalog 1927.

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